THE

JOURNAL

OF

THE LINNEAN SOCIETY.

BOTANY.

VOL. IX.

LONDON:

SOLD AT THE SOCIETY'S APARTMENTS, BURLINGTON HOUSE;

AND BY

LONGMANS, GREEN, READER, AND DYER,

AND

WILLIAMS AND NORGATE

1867.

PRINTED BY TAYLOR AND FRANCIS,
RED LION COURT, FLEET STREET.

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ERRATA.

Page 184, fourth line from bottom of page, for *intumescens* read *tumidula.*

Page 191, first line of page, *for* incrassata *read* incrassatis.

THE JOURNAL

OF

THE LINNEAN SOCIETY.

On the Movements and Habits of Climbing Plants. By Charles Darwin, Esq., F.R.S., F.L.S. &c.

[Read February 2, 1865.]

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I was led to this subject by an interesting, but too short, paper by Professor Asa Gray on the movements of the tendrils of some Cucurbitaceous plants*. My observations were more than half completed before I became aware that the surprising phenomenon of the spontaneous revolutions of the stems and tendrils of climbing plants had been long ago observed by Palm and by Hugo von Mohl†, and had subsequently been the subject of two

* Proc. Amer. Acad. of Arts and Sciences, vol. iv. Aug. 12, 1858, p. 98.

† Ludwig H. Palm, Ueber das Winden der Pflanzen; Hugo von Mohl, Ueber den Bau und das Winden der Ranken und Schlingpflanzen, 1827. Palm's

memoirs by Dutrochet*. Nevertheless I believe that my observations, founded on the close examination of above a hundred widely distinct living plants, contain sufficient novelty to justify me in laying them before the Society.

Climbing plants may be conveniently divided into those which spirally twine round a support, those which ascend by the movement of the foot-stalks or tips of their leaves, and those which ascend by true tendrils,—these tendrils being either modified leaves or flower-peduncles, or perhaps branches. But these subdivisions, as we shall see, nearly all graduate into each other. There are two other distinct classes of climbing-plants, namely those furnished with hooks and those with rootlets; but, as such plants exhibit no special movements, we are but little concerned with them; and generally, when I speak of climbing plants, I refer exclusively to the first great class.

Part I.—Spirally twining Plants.

This is the largest subdivision, and is apparently the primordial and simplest condition of the class. My observations will be best given by taking a few special cases. When the shoot of a Hop (*Humulus Lupulus*) rises from the ground, the two or three first-formed internodes are straight and remain stationary; but the next-formed, whilst very young, may be seen to bend to one side and to travel slowly round towards all points of the compass, moving, like the hands of a watch, with the sun. The movement very soon acquires its full ordinary velocity. From seven observations made during August on shoots proceeding from a plant which had been cut down, and on another plant during April, the average rate during hot weather and during the day was 2 h. 8 m. for each revolution; and none of the revolutions varied much from this rate. The revolving movement continues as long as the plant continues to grow; but each separate internode, as it grows old, ceases to move.

To ascertain more precisely what amount of movement each internode underwent, I kept a potted plant in a well-warmed room to which I was confined during the night and day. A long inclined shoot projected beyond the upper end of the supporting

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Treatise was published only a few weeks before Mohl's. See also 'The Vegetable Cell' (translated by Henfrey), by H. von Mohl, p. 147 to end.

* "Des Mouvements révolutifs spontanés," &c., 'Comptes Rendus,' tom. xvii. (1843) p. 989; "Recherches sur la Volubilité des Tiges," &c., tom. xix. (1844) p. 295.

stick, and was steadily revolving. I then took a longer stick and tied up the shoot, so that only a very young internode, $1\frac{3}{4}$ of an inch in length, was left free; this was so nearly upright that its revolution could not be easily observed; but it certainly moved, and the side of the internode which was at one time convex became concave, which, as we shall hereafter see, is a sure sign of the revolving movement. I will assume that it made at least one revolution during the first twenty-four hours. Early the next morning its position was marked, and it made the second revolution in 9 h.; during the latter part of this revolution it moved much quicker, and the third circle was performed in the evening in a little over 3 h. As on the succeeding morning I found that the shoot revolved in 2 h. 45 m., it must have made during the night four revolutions, each at the average rate of a little over 3 h. I should add that the temperature of the room varied only a little. The shoot had now grown $3\frac{1}{2}$ inches in length, and carried at its extremity a young internode 1 inch in length, which showed slight changes in its curvature. The next or ninth revolution was effected in 2 h. 30 m. From this time forward, the revolutions were easily observed. The thirty-sixth revolution was performed at the usual rate; so was the last or thirty-seventh, but it was not quite completed; for the internode abruptly became upright, and, after moving to the centre, remained motionless. I tied a weight to its upper end, so as to slightly bow it, and thus to detect any movement; but there was none. Some time before the last revolution the lower part of the internode had ceased to move.

A few more remarks will complete all that need be said on this one internode. It moved during five days; but the more rapid movement after the third revolution lasted during three days and twenty hours. The regular revolutions, from the ninth to thirty-sixth inclusive, were performed at the average rate of 2 h. 31 m.: the weather was cold; and this affected the temperature of the room, especially during the night, and consequently retarded a little the rate of movement. There was only one irregular movement, when a segment of a circle was rapidly performed (not counted in the above enumeration); and this occurred after an unusually slow revolution of 2 h. 49 m. After the seventeenth revolution the internode had grown from $1\frac{3}{4}$ to 6 inches in length, and carried an internode $1\frac{7}{8}$ inch long, which was just perceptibly moving; and this carried a very minute ultimate internode. After the twenty-first revolution, the penultimate internode was $2\frac{1}{2}$ inches long, and probably revolved in a period of about three hours. At the

twenty-seventh revolution our lower internode was $8\frac{3}{8}$, the penultimate $3\frac{1}{2}$, and ultimate $2\frac{1}{2}$ inches in length; and the inclination of the whole shoot was such, that a circle 19 inches in diameter was swept by it. When the movement ceased, the lower internode was 9 and the penultimate 6 inches in length; so that, from the twenty-seventh to thirty-seventh revolutions inclusive, three internodes were at the same time revolving.

The lower internode, when it ceased revolving, became upright and rigid; but as the whole shoot continued to grow unsupported, it became nearly horizontal, the uppermost and growing internodes still revolving at the extremity, but of course no longer round the old central point of the supporting stick. From the change in the position of the centre of gravity of the revolving extremity, a slight and slow swaying movement was given to the long and horizontally projecting shoot, which I mistook at first for a spontaneous movement. As the shoot grew, it depended more and more, whilst the growing and revolving extremity turned itself up more and more.

With the Hop we have seen that three internodes were at the same time revolving; and this was the case with most of the plants observed by me. With all, if in full health, two revolved; so that by the time one had ceased, that above it was in full action, with a terminal internode just commencing to revolve. With *Hoya carnosa*, on the other hand, a depending shoot, 32 inches in length, without any developed leaves, and consisting of seven internodes (a minute terminal one, an inch in length, being counted), continually, but slowly, swayed from side to side in a semicircular course, with the extreme internodes making complete revolutions. This swaying movement was certainly due to the movement of the lower internodes, which, however, had not force sufficient to swing the whole shoot round the central supporting stick. The case of another Asclepiadaceous plant, viz. *Ceropegia Gardnerii* is worth briefly giving. I allowed the top to grow out almost horizontally to the length of 31 inches; this now consisted of three long internodes, terminated by two short ones. The whole revolved in a course opposed to the sun (the reverse of that of the Hop), at rates between 5 h. 15 m. and 6 h. 45 m. for each revolution. Hence, as the extreme tip made a circle of above 5 feet (or 62 inches) in diameter and 16 feet in circumference, the tip travelled at the rate (assuming the circuit to have been completed in six hours) of 32 or 33 inches per hour. The weather being hot, the plant was allowed to stand on my study-table; and it was an interesting

spectacle to watch the long shoot sweeping, night and day, this grand circle in search of some object round which to twine.

If we take hold of a growing sapling, we can of course bend it so as to make its tip describe a circle, like that performed by the tip of a spontaneously revolving plant. By this movement the sapling is not in the least twisted round its own axis. I mention this because if a black point be painted on the bark, on the side which is uppermost when the sapling is bent towards the holder's body, as the circle is described, the black point gradually turns round and sinks to the lower side, and comes up again when the circle is completed; and this gives the false appearance of twisting, which, in the case of spontaneously revolving plants, deceived me for a time. The appearance is the more deceitful because the axes of nearly all twining-plants are really twisted; and they are twisted in the same direction with the spontaneous revolving movement. To give an instance, the internode of the Hop of which the history has been recorded was at first, as could be seen by the ridges on its surface, not in the least twisted; but when, after the 37th revolution, it had grown 9 inches long, and its revolving movement had ceased, it had become twisted three times round its own axis, in the line of the course of the sun; on the other hand, the common Convolvulus, which revolves in an opposite course to the Hop, becomes twisted in an opposite direction.

Hence it is not surprising that Hugo von Mohl (S. 105, 108, &c.) thought that the twisting of the axis caused the revolving movement. I cannot fully understand how the one movement is supposed to cause the other; but it is scarcely possible that the twisting of the axis of the Hop three times could have caused thirty-seven revolutions. Moreover, the revolving movement commenced in the young internode before any twisting of the axis could be detected; and the internode of a young Siphomeris or Lecontea revolved during several days, and became twisted only once on its own axis. But the best evidence that the twisting does not cause the revolving movement is afforded by many leaf-climbing and tendril-bearing plants (as *Pisum sativum*, *Echinocystis lobata*, *Bignonia capreolata*, *Eccremocarpus scaber*, and with the leaf-climbers, *Solanum jasminoides* and various species of *Clematis*), of which the internodes are not regularly twisted, but which regularly perform, as we shall hereafter see, revolving movements like those of true twining-plants. Moreover, according to Palm (S. 30, 95) and Mohl (S. 149), and Léon *, internodes may occasionally, and even not very rarely, be found which are

* Bull. Bot. Soc. de France, tom. v. 1858, p. 356.

twisted in an opposite direction to the other internodes on the same plant, and to the course of revolution; and this, according to Léon (p. 356), is the case with all the internodes of a variety of the *Phaseolus multiflorus.* Internodes which have become twisted round their own axes, if they have not ceased revolving, are still capable of twining, as I have several times observed.

Mohl has remarked (S. 111) that when a stem twines round a smooth cylindrical stick, it does not become twisted. Accordingly I allowed kidney-beans to run up stretched string, and up smooth rods of iron and glass, one-third of an inch in diameter, and they became twisted only in that degree which follows as a mechanical necessity from the spiral winding. The stems, on the other hand, which had ascended the ordinary rough sticks were all more or less and generally much twisted. The influence of the roughness of the support in causing axial twisting was well seen in the stems which had twined up the glass rods; for these were fixed in split sticks below, and were secured above to cross sticks, and the stems in passing these places became very much twisted. As soon as the stems which had ascended the iron rods reached the summit and became free, they also became twisted; and this apparently occurred more quickly during windy weather. Several other facts could be given, showing that the axial twisting stands in relation to inequalities in the support, and likewise to the shoot revolving freely without any support. Many plants, which are not twiners, become in some degree twisted round their own axes*; but this occurs so much more generally and strongly with twining-plants than with other plants, that there must be some connexion between the capacity for twining and axial twisting. The most probable view, as it seems to me, is that the stem twists itself to gain rigidity (on the same principle that a much twisted rope is stiffer than a slackly twisted one), so as to be enabled either to pass over inequalities in its spiral ascent, or to carry its own weight when allowed to revolve freely†.

* Professor Asa Gray has remarked to me, in a letter, that in *Thuja occidentalis* the twisting of the bark is very conspicuous. The twist is generally to the right of the observer; but, in noticing about a hundred trunks, four or five were observed to be twisted in an opposite direction.

† It is well known that stems of many plants occasionally become spirally twisted in a monstrous manner; and since the reading of this paper, Dr. Maxwell Masters has remarked to me in a letter that "some of these cases, if not all, are dependent upon some obstacle or resistance to their upward growth." This conclusion agrees with, and perhaps explains, the normal axial twisting of twining-plants; but does not preclude the twisting being of service to the plant and giving greater rigidity to the stem.

I have just alluded to the twisting which necessarily follows from the spiral ascent of the stem, namely, one twist for each spire completed. This was well shown by painting straight lines on stems, and then allowing them to twine; but, as I shall have to recur to this subject under Tendrils, it may be here passed over.

I have already compared the revolving movement of a twining plant to that of the tip of a sapling, moved round and round by the hand held some way down the stem; but there is a most important difference. The upper part of the sapling moves as a rigid body, and remains straight; but with twining plants every inch of the revolving shoot has its own separate and independent movement. This is easily proved; for when the lower half or two-thirds of a long revolving shoot is quietly tied to a stick, the upper free part steadily continues revolving: even if the whole shoot, except the terminal tip of an inch or two in length, be tied up, this tip, as I have seen in the case of the Hop, Ceropegia, Convolvulus, &c., goes on revolving, but much more slowly; for the internodes, until they have grown to some little length, always move slowly. If we look to the one, two, or several internodes of a revolving shoot, they will be all seen to be more or less bowed either during the whole or during a large part of each revolution. Now if a coloured streak be painted (this was done with a large number of twining plants) along, we will say, the convex line of surface, this coloured streak will after a time (depending on the rate of revolution) be found to lie along one side of the bow, then along the concave side, then on the opposite side, and, lastly, again on the original convex surface. This clearly proves that the internodes, during the revolving movement, become bowed in every direction. The movement is, in fact, a continuous self-bowing of the whole shoot, successively directed to all points of the compass.

As this movement is rather difficult to understand, it will be well to give an illustration. Let us take the tip of a sapling and bend it to the south, and paint a black line on the convex surface; then let the sapling spring up and bend it to the east, the black line will then be seen on the lateral face (fronting the north) of the shoot; bend it to the north, the black line will be on the concave surface; bend it to the west, the line will be on the southern lateral face; and when again bent to the south, the line will again be on the original convex surface. Now, instead of bending the sapling, let us suppose that the cells on its whole southern surface were to contract from the base to the tip, the whole shoot would be bowed to the south; and let the longi-

tudinal contracting surface slowly creep round the shoot, deserting by slow degrees the southern side and encroaching on the eastern side, and so round by the north, by the west, again to the south; in this case the shoot would remain always bowed with the painted line appearing on the convex, on the lateral, and concave surfaces, and with the point of the shoot successively directed to all points of the compass. In fact, we should then have the exact kind of movement seen in the revolving shoots of twining plants. I have spoken in the illustration, for brevity's sake, of the cells along each face successively contracting; of course turgescence of the cells on the opposite face, or both forces combined, would do equally well.

It must not be supposed that the revolving movement of twining plants is as regular as that given in this illustration; in very many cases the tip describes an ellipse, even a very narrow ellipse. To recur once again to our illustration, if we suppose the southern and then the northern face of the sapling to contract, the summit would describe a simple arc; if the contraction first travelled a very little to the eastern face, and during the return a very little to the western face, a narrow ellipse would be described; and the sapling would become straight as it passed to and fro by the central point. A complete straightening of the shoot may often be observed in revolving plants; but the weight of the shoot apparently interferes with the regularity of the movement, and with the place of straitening. The movement is often (in appearance at least) as if the southern, eastern, and northern faces had contracted, but not the western face; so that a semicircle is described, and the shoot becomes straight and upright in one part of its course.

When a revolving shoot consists of several internodes, the several lower ones bend together at the same rate, but the one or two terminal internodes bend at a slower rate; hence, though at times all the internodes may be bowed in the same line, at other times the shoot is rendered slightly serpentine, as I have often observed. The rate of revolution of the whole shoot, if judged by the movement of the extreme tip, is thus at times accelerated and retarded. One other point must be noticed. Authors have observed that the end of the shoot in many twining plants is completely hooked; this is very general, for instance, with the Asclepiadaceæ. The hooked tip, in all the cases which I observed, viz. in *Ceropegia*, *Sphærostema*, *Clerodendron*, *Wistaria*, *Stephania*, *Akebia*, and *Siphomeris*, has exactly the same kind of movement as the other revolving internodes; for a line painted

on the convex surface becomes lateral and then concave; but, owing to the youth of these terminal internodes, the reversal of the hook is a slower process than the revolving movement. This strongly marked tendency in the young terminal and flexible internodes to bend more abruptly than the other internodes is of service to the plant; for not only does the hook thus formed sometimes serve to catch a support, but (and this seems to be much more important) it causes the extremity of the shoot to embrace much more closely its support than it otherwise could have done, and thus aids in preventing the stem from being blown away from it during windy weather, as I have many times observed. In *Lonicera brachypoda* the hook only straightened itself periodically, and never became reversed. I will not assert that the tips of all twining plants, when hooked, move as above described; for this position may in some cases be due to the manner of growth, as with the bent tips of the shoots of the common vine, and more plainly with those of *Cissus discolor*; these plants, however, are not spiral twiners.

The purpose of the spontaneous revolving movement, or, more strictly speaking, of the continuous bending movement successively directed to all points of the compass, is, as Mohl has remarked, obviously in part to favour the shoot finding a support. This is admirably effected by the revolutions carried on night and day, with a wider and wider circle swept as the shoot increases in length. But as we now understand the nature of the movement, we can see that, when at last the shoot meets with a support, the motion at the point of contact is necessarily arrested, but the free projecting part goes on revolving. Almost immediately another and upper point of the shoot is brought into contact with the support and is arrested; and so onwards to the extremity of the shoot; and thus it winds round its support. When the shoot follows the sun in its revolving course, it winds itself round the support from right to left, the support being supposed to stand in front of the beholder; when the shoot revolves in an opposite direction, the line of winding is reversed. As each internode loses from age its power of revolving, it loses its power of spirally twining round a support. If a man swings a rope round his head, and the end hits a stick, it will coil round the stick according to the direction of the swinging rope; so it is with twining plants, the continued contraction or turgescence of the cells along the free part of the shoot replacing the momentum of each atom of the free end of the rope.

All the authors, except Von Mohl, who have discussed the

spiral twining of plants maintain that such plants have a natural tendency to grow spirally. Mohl believes (S. 112) that twining stems have a dull kind of irritability, so that they bend towards any object which they touch. Even before reading Mohl's interesting treatise, this view seemed to me so probable that I tested it in every way that I could, but always with negative results. I rubbed many shoots much harder than is necessary to excite movement in any tendril or in any foot-stalk of a leaf-climber, but without result. I then tied a very light forked twig to a shoot of a Hop, a *Ceropegia*, *Sphærostema*, and *Adhatoda*, so that the fork pressed on one side alone of the shoot and revolved with it; I purposely selected some very slow revolvers, as it seemed most likely that these would profit from possessing irritability; but in no case was any effect produced. Moreover, when a shoot winds round a support, the movement is always slower, as we shall immediately see, than whilst its revolves freely and touches nothing. Hence I conclude that twining stems are not irritable; and indeed it is not probable that they should be so, as nature always economizes her means, and irritability would be superfluous. Nevertheless I do not wish to assert that they are never irritable; for the growing axis of the leaf-climbing, but not spirally twining, *Lophospermum scandens* is, as we shall hereafter see, certainly irritable; but this case gives me confidence that ordinary twiners do not possess this quality, for directly after putting a stick to the *Lophospermum*, I saw that it behaved differently from any true twiner or any other leaf-climber.

The belief that twiners have a natural tendency to grow spirally probably arose from their assuming this form when wound round a support, and from the extremity, even whilst remaining free, sometimes assuming this same form. The free internodes of vigorously growing plants, when they cease to revolve, become straight, and show no tendency to be spiral; but when any shoot has nearly ceased to grow, or when the plant is unhealthy, the extremity does occasionally become spiral. I have seen this in a remarkable degree with the ends of the shoots of the *Stauntonia* and of the allied *Akebia*, which became closely wound up spirally, just like a tendril, especially after the small, ill-formed leaves had perished. The explanation of this fact is, I believe, that the lower parts of such terminal internodes very gradually and successively lose their power of movement, whilst the portions just above move onwards, and in their turn become motionless; and this ends in forming an irregular spire.

When a revolving shoot strikes a stick, it winds round it rather more slowly than it revolves. For instance, a shoot of the *Ceropegia* took 9 h. 30 m. to make one complete spire round a stick, whilst it revolved in 6 h.; *Aristolochia gigas* revolved in about 5 h., but took 9 h. 15 m. to complete its spire. This, I presume, is due to the continued disturbance of the moving force by its arrestment at each successive point; we shall hereafter see that even shaking a plant retards the revolving movement. The terminal internodes of a long, much-inclined, revolving shoot of the *Ceropegia*, after they had wound round a stick, always slipped up it, so as to render the spire more open than it was at first; and this was evidently due to the force which caused the revolutions being now almost freed from the constraint of gravity, and allowed to act freely. With the *Wistaria*, on the other hand, a long horizontal shoot wound itself at first in a very close spire, which remained unchanged; but subsequently, as the shoot grew, it made a much more open spire. With all the many plants which were allowed freely to ascend a support, the terminal internodes made at first a close spire; and this, during windy weather, well served to keep the shoots in contact with their support; but as the penultimate internodes grew in length, they pushed themselves up for a considerable space (ascertained by coloured marks on the shoot and on the support) round the stick, and the spire became more open.

It follows from this latter fact that the position occupied by each leaf with respect to the support, in fact, depends on the growth of the internodes after they have become spirally wound round it. I mention this on account of an observation by Palm (S. 34), who states that the opposite leaves of the Hop always stand exactly over each other, in a row, on the same side of the supporting stick, though this may differ in thickness. My sons visited a hop-field for me, and reported that though they generally found the points of insertion of the leaves over each other for a space of two or three feet in height, yet this never occurred up the whole length of a pole, the point of insertion forming, as might have been expected, an irregular spire. Any irregularity in the pole entirely destroyed the regularity of position of the leaves. From casual inspection, it appeared to me that the opposite leaves of *Thunbergia alata* were arranged in a line up the sticks round which they had twined; accordingly I raised a dozen plants, and gave them sticks of various thicknesses and string to twine round; and in this case one alone out of the

dozen had its leaves arranged in a perpendicular line: so I conclude that there is nothing remarkable in Palm's statement.

The leaves of twining-plants rise from the stem (before it has twined) either alternately, or oppositely, or in a spire; in this latter case the line of insertion of the leaves and the course of revolution or of twining coincide. This fact has been well shown by Dutrochet *, who found different individuals of *Solanum Dulcamara* twining in opposite directions, and these had their leaves spirally arranged in opposite directions. A dense whorl of many leaves would apparently be incommodious for a twining plant, and some authors have supposed that none have their leaves thus arranged; but a twining *Siphomeris* has whorls of three.

If a stick which has arrested a revolving shoot, but has not as yet been wound round, be suddenly taken away, the shoot generally springs forward, showing that it has continued to press against the stick. If the stick, shortly after having been wound round, be withdrawn, the shoot retains for a time its spiral form, then straightens itself, and again commences to revolve. The long, much-inclined shoot of the *Ceropegia* previously alluded to offered some curious peculiarities. The lower and older internodes, which continued to revolve, had become so stiff that they were incapable, on repeated trials, of twining round a thin stick, showing that the power of movement was retained after flexibility had been lost. I then moved the stick to a greater distance, so that it was struck by a point $2\frac{1}{2}$ inches from the extremity of the penultimate internode; and it was then neatly wound round by this part and by the ultimate internode. After leaving the spirally wound shoot for eleven hours, I quietly withdrew the stick, and in the course of the day the curled part straightened itself and recommenced revolving; but the lower and not curled portion of the penultimate internode did not move, a sort of hinge separating the moving and the motionless part of the same internode. After a few days, however, I found that the lower part of this internode had likewise recovered its revolving power. These several facts show that, in the arrested portion of a revolving shoot, the power of movement is not immediately lost, and that when temporarily lost it can be recovered. When a shoot has remained for a considerable time wound round its support, it permanently retains its spiral form even when the support is removed.

* Comptes Rendus, 1844, tom. xix. p. 295, and Annales des Soc. Nat. 3rd series, Bot., tom. ii. p. 163.

When a stick was placed so as to arrest the lower and rigid internodes of the *Ceropegia* at the distance at first of 15 and then of 21 inches from the centre of revolution, the shoot slowly and gradually slid up the stick, so as to become more and more highly inclined; and then, after an interval sufficient to have allowed of a semirevolution, it suddenly bounded from the stick and fell over to the opposite side, to its ordinary slight inclination. It now recommenced revolving in its usual course, so that after a semirevolution it again came into contact with the stick, again slid up it, and again bounded from it. This movement of the shoot had a very odd appearance, as if it were disgusted with its failure but resolved to try again. We shall, I think, understand this movement by considering the former illustration of the sapling, in which the contracting surface was supposed to creep from the southern, by the eastern, to the northern, and thence back again by the western side to the southern face, successively bowing the sapling in all directions. Now with the *Ceropegia*, the stick being placed a very little to the east of due south of the plant, the eastern contraction could produce no effect beyond pressing the rigid internode against the stick; but as soon as the contraction on the northern face began, it would slowly drag the shoot up the stick; and then, as soon as the western contraction had well begun, the shoot would be drawn from the stick, and its weight, coinciding with the north-western contraction, would cause it suddenly to fall to the opposite side with its proper slightly inclined positions; and the ordinary revolving movement would go on. I have described this case because it first made me understand the order in which the contracting or turgescent cells of revolving shoots must act.

The view just given further explains, as I believe, a fact observed by Von Mohl (S. 135), namely, that a revolving shoot, though it will twine round an object as thin as a thread, cannot do so round a thick support. I placed some long revolving shoots of a *Wistaria* close to a post between 5 and 6 inches in diameter, but they could not, though aided by me in many ways, wind round it. This apparently is owing to the flexure of the shoot, when winding round an object so gently curved as this post, not being sufficient to hold the shoot to its place when the contracting force creeps round to the opposite surface of the shoot; so that it is at each revolution withdrawn from its support.

When a shoot has grown far beyond its support, it sinks downwards from its weight, as already explained in the case of the

Hop, with the revolving end always turning upwards. If the support be not lofty, it falls to the ground, and, resting there, the extremity rises again. Sometimes several shoots, when flexible, twine together into a cable, and thus support each other. Single thin depending shoots, such as those of the *Sollya Drummondii*, will turn abruptly back and wind upwards on themselves. The greater number of the depending shoots, however, of one twining plant, the *Hibbertia dentata*, showed but little tendency to turn upwards. In other cases, as with the *Cryptostegia grandiflora*, several internodes which at first were flexible and revolved, if they did not succeed in twining round a support, became quite rigid, and, supporting themselves upright, carried on their summit the younger revolving internodes.

Here will be a convenient place to give a Table showing the direction and rate of movement of several twining plants, with a few appended remarks. These plants are arranged according to Lindley's 'Vegetable Kingdom' of 1853; and they have been selected from all parts of the series to show that all kinds behave in a nearly uniform manner*.

Twining plants not aided by tendrils or by irritable leaf-stalks.

(ACOTYLEDONS.)

Lygodium scandens (Polypodiaceæ) moves against the sun.

	h. m.			h. m.	
June 18, 1st circle	6 0	[ing).	June 19, 4th circle	5 0	(very hot day).
,, 18, 2nd ,,	6 15	(late in even-	,, 20, 5th ,,	6 0	
,, 19, 3rd ,,	5 32	(very hot day).			

Lygodium articulatum moves against the sun.

	h. m.			h. m.
July 19, 1st circle	16 30	(shoot very	July 21, 3rd circle	8 0
,, 20, 2nd ,,	15 0	[young).	,, 22, 4th ,, ...	10 30

(MONOCOTYLEDONS.)

Ruscus androgynus (Liliaceæ), placed in the hot-house, moves against the sun.

	h. m.			h. m.
May 24, 1st circle	6 14	(shoot very	May 26, 5th circle......	2 50
,, 25, 2nd ,,	2 21	[young).	,, 27, 6th ,, ...	3 52
,, 25, 3rd ,,	3 37		,, 27, 7th ,, ...	4 11
,, 25, 4th ,,	3 22			

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* I am much indebted to Dr. Hooker for having sent me many plants from Kew; and to Mr. Veitch, of the Royal Exotic Nursery, for having generously given me a large collection of fine specimens of climbing plants. Professor Asa Gray, Prof. Oliver, and Dr. Hooker have afforded me, as on many previous occasions, much information and many valuable references.

(MONOCOTYLEDONS, *continued.*)

Asparagus (unnamed species from Kew) (Liliaceæ) moves against the sun, placed in hothouse.

	h. m.
Dec. 26, 1st circle	5 0
„ 27, 2nd „	5 40

Tamus communis (Dioscoreaceæ). A young shoot from a potted tuber placed in the greenhouse; follows the sun.

	h. m.		h. m.
July 7, 1st circle	3 10	July 8, 4th circle	2 56
„ 7, 2nd „	2 38	„ 8, 5th „	2 30
„ 8, 3rd „	3 5	„ 8, 6th „	2 30

Lapagerea rosea (Philesiaceæ), in greenhouse, follows the sun.

	h. m.	
March 9, 1st circle	26 15	(shoot young).
„ 10, semicircle	8 15	
„ 11, 2nd circle	11 0	
„ 12, 3rd „	15 30	
„ 13, 4th „	14 15	
„ 16, 5th „	8 40	when placed in the hothouse; but the next day the shoot remained stationary.

Roxburghia viridiflora (Roxburghiaceæ) moves against the sun; it travelled a circle in about 24 hours.

(DICOTYLEDONS.)

Humulus Lupulus (Urticaceæ) follows the sun.

	h. m.		h. m.
April 9, 2 circles	4 16	August 14, 6th circle	2 2
Aug. 13, 3rd circle	2 0	„ 14, 7th „	2 0
„ 14, 4th „	2 20	„ 14, 8th „	2 4
„ 14, 5th „	2 16		

A plant placed in a room; a semicircle was performed in travelling from the light in 1 h. 33 m., in travelling to the light in 1 h. 13 m.: difference of rate 20 m.

Akebia quinata (Lardizabalaceæ), placed in hothouse, moves against the sun.

	h. m.			h. m.
March 17, 1st circle	4 0	(shoot	March 18, 3rd circle	1 30
„ 18, 2nd „	1 40	young).	„ 19, 4th „	1 45

Stauntonia latifolia (Lardizabalaceæ), placed in hothouse, moves against the sun.

	h. m.
March 28, 1st circle	3 30
„ 29, 2nd „	3 45

Sphærostema marmoratum (Schizandraceæ) follows the sun.

August 5th, 1st circle in about 24 h.; 2nd circle in 18 h. 30 m.

Stephania rotunda (Menispermaceæ) moves against the sun.

	h. m.		h. m.
May 27, 1st circle	5 5	June 2, 3rd circle	5 15
„ 30, 2nd „	7 6	„ 3, 4th „	6 28

(DICOTYLEDONS, *continued.*)

Thryallis brachystachya (Malpighiaceæ) moves against the sun: one shoot made a circle in 12 h., and another in 10 h. 30 m.; but the next day, which was much colder, the first shoot in my study took 10 h. to perform only a semicircle.

Hibbertia dentata (Dilleniaceæ), placed in the hothouse, followed the sun, and made (May 18th) a circle in 7 h. 20 m.; on the 19th, reversed its course and moved against the sun, and made a circle in 7 h.; on the 20th, moved against the sun one-third of circle, and then stood still; on the 26th, followed the sun for two-thirds of circle, and then returned to its starting-point, taking for this double course 11 h. 46 m.

Sollya Drummondii (Pittosporaceæ) moves against the sun; in greenhouse.

	h. m.			h. m.
April 4, 1st circle	4 25		April 6, 3rd circle......	6 25
,, 5, 2nd ,,	8 0	(very cold [day.)	,, 7, 4th ,, ...	7 5

Polygonum dumetorum (Polygonaceæ). This case is taken from Dutrochet (p. 299), as I observed no allied plant; follows the sun. Three shoots cut off and placed in water made circles in 3 h. 10 m., 5 h. 20 m., and 7 h. 15 m.

Wistaria Chinensis (Leguminosæ), in greenhouse, moves against the sun.

	h. m.		h. m.
May 13, 1st circle......	3 5	May 24, 4th circle......	3 21
,, 13, 2nd ,, ...	3 20	,, 25, 5th ,, ...	2 37
,, 16, 3rd ,, ...	2 5	,, 25, 6th ,, ...	2 35

Phaseolus vulgaris (Leguminosæ), in greenhouse, moves against the sun.

	h. m.
May, 1st circle	2 0
,, 2nd ,, ...	1 55
,, 3rd ,, ...	1 55

Dipladenia urophylla (Apocynaceæ) moves against the sun.

	h. m.
April 18, 1st circle....................	8 0
,, 19, 2nd ,, ...	9 15
,, 30, 3rd ,, ...	9 40

Dipladenia crassinoda moves against the sun.

	h. m.
May 16, 1st circle	9 5
July 20, 2nd ,, ...	8 0
,, 21, 3rd ,, ...	8 5

Ceropegia Gardnerii (Asclepiadaceæ) moves against the sun.

		h. m.
Shoot very young, 2 inches in length.	1st circle in	7 55
Shoot still young	2nd ,,	7 0
Long shoot	3rd ,,	6 33
Long shoot	4th ,,	5 15
Long shoot	5th ,,	6 45

Stephanotis floribunda (Asclepiadaceæ) moves against the sun, and made a circle in 6 h. 40 m., a second circle in about 9 hours.

(Dicotyledons, *continued.*)

Hoya carnosa (Asclepiadaceæ) made several circles in from 16 h. to 22 h. or 24 h.

Convolvulus major (Convolvulaceæ) moves against the sun. Plant placed in room with lateral light.

1st circle ...	2 h. 42 m.	Semicircle, from light in 1 h. 14 m., to light 1 h. 28 m.: difference 14 m.
2nd circle...	2 h. 47 m.	Semicircle, from light in 1 h. 17 m., to light 1 h. 30 m.: difference 13 m.

Convolvulus sepium (large-flowered cultivated var.) moves against the sun. Two circles, each in 1 h. 42 m.: difference in semicircle from and to light 14 m.

Ipomæa jucunda (Convolvulaceæ) moves against the sun, placed in my study, with windows facing the north-east. Weather hot.

1st circle 5 h. 30 m.	Semicircle, from light in 4 h. 30 m., to light 1 h. 0 m.: difference 3 h. 30 m.
2nd circle 5 h. 20 m. (Late in afternoon: circle completed at 6 m. 40 h. P.M.)	Semicircle, from light in 3 h. 50 m., to light 1 h. 30 m.: difference 2 h. 20 m.

We have here a remarkable instance of the power of light in retarding and hastening the revolving movement.

Rivea tiliæfolia (Convolvulaceæ) moves against the sun, and made four revolutions in 9 h.; so that each, on average, was performed in 2 h. 15 m.

Plumbago rosea (Plumbaginaceæ) follows the sun. The shoot did not begin to revolve until nearly a yard in height; it then made a fine circle in 10 h. 45 m. During the next few days it continued to move, but irregularly. On August 15th the shoot followed, during a period of 10 h. 40 m., a long and deeply zigzag course and then made a broad ellipse. The figure thus traced altogether apparently represented three ellipses, each of which averaged 3 h. 33 m. for its completion.

Jasminum pauciflorum, Bentham (Jasminaceæ), moves against the sun. First circle in 7 h. 15 m., second circle rather more quickly.

Clerodendrum Thomsonii (Verbenaceæ) follows the sun.

	h. m.	
April 12, 1st circle	5 45	(shoot very young).
„ 14, 2nd „	3 30	
„ 18, semicircle	5 0	(directly after the plant was shaken in
„ 19, 3rd circle	3 0	[being moved).
„ 20, 4th „	4 20	

Tecoma jasminoides (Bignoniaceæ) moves against sun.

	h. m.		h. m.	
March 17, 1st circle	6 30	March 22, 3rd circle	8 30	(very cold
„ 19, 2nd „	7 0	„ 24, 4th „	6 45	[day).

Thunbergia alata (Acanthaceæ) moves against sun.

	h. m.		h. m.	
April 14, 1st circle	3 20	April 18, 3rd circle	2 55	[noon).
„ 18, 2nd „	2 50	„ 18, 4th „	3 55	(late in after-

Adhadota cydonæfolia (Acanthaceæ) follows the sun. A young shoot made

(Dicotyledons, *continued.*)

a semicircle in 24 h.; subsequently made a circle in between 40 h. and 48 h.; subsequently did not complete a circle in 50 h. Another shoot, however, made a circle in 26 h. 30 m.

Mikania scandens (Compositæ) moves against the sun.

		h. m.	
March	14, 1st circle	3 10	
,,	15, 2nd ,,	3 0	
,,	16, 3rd ,,	3 0	
,,	17, 4th ,,	3 33	
April	7, 5th ,,	2 50	
,,	7, 6th ,,	2 40	This circle was made after a copious intentional watering with cold water at 47° Fahr.

Combretum argenteum (Combretaceæ) moves against the sun.

	h. m.	
Jan. 24, 1st circle	2 55	Early in morning, when the temperature of the house had fallen a little.
,, 24, 2 circles, each at an average of	2 20	
	2 20	
,, 25, 4th circle	2 25	

Combretum purpureum revolves not quite so quickly as *C. argenteum.*

Loasa aurantiaca (Loasaceæ). First plant moved against the sun.

	h. m.		h. m.
June 20, 1st circle......	2 37	June 21, 4th circle......	2 35
,, 20, 2nd ,, ...	2 13	,, 22, 5th ,, ...	3 26
,, 20, 3rd ,, ...	4 0	,, 23, 6th ,, ...	3 5

Second plant followed the sun.

	h. m.	
July 11, 1st circle...........	1 51	Very hot day.
,, 11, 2nd ,, ...	1 46	
,, 11, 3rd ,, ...	1 41	
,, 11, 4th ,, ...	1 48	
,, 12, 5th ,, ...	2 35	Cool morning.

Scyphanthus elegans (Loasaceæ) follows the sun.

	h. m.		h. m.
June 13, 1st circle......	1 45	June 14, 4th circle......	1 59
,, 13, 2nd ,, ...	1 17	,, 14, 5th ,, ...	2 3
,, 14, 3rd ,, ...	1 36		

Siphomeris or *Lecontea* (unnamed sp.) (Cinchonaceæ) follows the sun.

		h. m.	
May	25, semicircle	10 27	(shoot extremely young).
,,	26, 1st circle	10 15	(shoot still young).
,,	30, 2nd ,, ...	8 55	
June	2, 3rd ,, ...	8 11	
,,	6, 4th ,, ...	6 8	
,,	8, 5th ,, ...	7 20	Taken from the hothouse and placed in a room in my house.
,,	9, 6th ,, ...	8 36	

Manettia bicolor (Cinchonaceæ), young plant, follows the sun.

	h. m.
July 7, 1st circle........................	6 18
,, 8, 2nd ,, ...	6 53
,, 9, 3rd ,, ...	6 30

(DICOTYLEDONS, *continued.*)

Lonicera brachypoda (Caprifoliaceæ) follows the sun, in a warm room in the house.

		h. m.	
April,	1st circle about	9 10	
,,	2nd ,, ,,	12 20	(another shoot very young).
,,	3rd ,, ,,	7 30	
,,	4th ,, ,,	8 0	In this latter circle, the semicircle from the light took 5 h. 23 m., and to the light 2 h. 37 m.: difference 2 h. 46 m.

Aristolochia gigas (Aristolochiaceæ) moves against the sun.

	h. m.	
July 22, 1st circle.........	8 0	(rather young shoot).
,, 23, 2nd ,, ...	7 15	
,, 24, 3rd ,, ...	5 0	(about).

In the foregoing table, which includes twining plants belonging to as widely different orders as is possible, we see that the contraction or turgescence of the cells circulating round the axis, on which the revolving movement depends, differs much in rate. As long as a plant remains under the same conditions, the rate is often remarkably uniform, as we see with the Hop, *Mikania*, *Phaseolus*, &c. The *Scyphanthus* made one revolution in 1 h. 17 m., and this is the quickest rate observed; but we shall afterwards see a tendril-bearing Passiflora revolving even more rapidly. A shoot of the *Akebia quinata* made a revolution in 1 h. 30 m., and three revolutions at the average rate of 1 h. 38 m.; a Convolvulus made two revolutions at the average of 1 h. 42 m., and *Phaseolus vulgaris* three at the average of 1 h. 57 m. On the other hand, some plants take 24 h. for a single revolution, and the *Adhadota* sometimes required 48 h.; yet this latter plant is an efficient twiner. Species of the same genus move at different rates. The rate does not seem governed by the thickness of the shoots: those of the *Sollya* are as thin and flexible as string, but move slower than the thick and fleshy shoots of the *Ruscus*, which seems so little fitted for movement of any kind; the shoots of the *Wistaria*, which become woody, move faster than those of the *Ipomæa* or *Thunbergia*.

We know that the internodes, whilst very young, do not acquire their proper rate of movement; hence several shoots on the same plant may sometimes be seen revolving at different rates. The two or three, or even more, internodes which are first formed above the cotyledons, or above the perennial root-stock, do not move; these first-formed shoots can support themselves, and nothing superfluous is granted them.

A greater number of twiners revolve in a course opposed to that of the sun, or to the hands of a watch, than in the reversed

course, and, consequently, the majority, as is well known, ascend their supports from left to right. Occasionally, though rarely, plants of the same order twine in opposite directions, of which Mohl (S. 125) gives a case in the Leguminosæ, and we have in the table another in the Acanthaceæ. At present no instance is known of two species of the same genus twining in opposite directions; and this is a singular fact, because different individuals of *Solanum dulcamara* (Dutrochet, tom. xix. p. 299) revolve and twine in both directions: this plant, however, is a most feeble twiner. *Loasa aurantiaca* (Léon, p. 351) offers a much more striking case: I raised seventeen plants: of these eight revolved in opposition to the sun, and ascended from left to right; five followed the sun, and ascended from right to left; and four revolved and twined first in one direction, and then reversed their course*, the petioles of the opposite leaves affording a *point d'appui* for the reversal of the spire. One of these four plants made seven spiral turns from right to left, and five turns from left to right. These individuals of the *Loasa* are interesting, as showing how almost every change is effected most gradually. For another plant in the same family, the *Scyphanthus elegans*, habitually twines in this manner. I raised many plants of it, and the stems of all took one turn, or occasionally two or even three turns in one direction, and then, ascending for a short space straight, reversed their course and took one or two turns in an opposite direction. The reversal of the curvature occurred at any point in the stem, even in the middle of an internode. Had I not seen this case, I should have thought its occurrence most improbable. It could hardly occur with any plant which ascended above a few feet in height, or which lived in an exposed situation; for the stem could be easily pulled from its support with little unwinding; nor could it have adhered at all, had not the internodes soon become moderately rigid. With leaf-climbers, as we shall soon see, analogous cases frequently occur; but these present no difficulty, as the stem is secured by the clasping petioles.

In the many other revolving and twining plants observed by me, I never but twice saw the movement reversed; once, and only for a short space, in *Ipomæa jucunda*; but frequently with *Hibbertia dentata*. This plant at first much perplexed me, for I continually observed its long and flexible shoots, evidently well fitted for twining, make a whole or half or quarter circle in one direction

* I raised nine plants of the hybrid *Loasa Herbertii*, and six of these reversed their spire in ascending their supports.

and then in the opposite direction; consequently, when I placed the shoots near thin or thick sticks, or stretched string, they seemed perpetually to be trying to ascend these supports, but failed. I then surrounded the plant with a mass of branched twigs; the shoots ascended, and passed through them, but several came out laterally, and their depending extremities seldom turned upwards as is usual with twining plants. Finally, I surrounded another plant with many thin upright sticks, and placed this plant near the other plant with the twigs; and now the *Hibbertia* had got what it liked, for it twined up the parallel sticks, sometimes winding round one and sometimes round several; and the shoots travelled laterally from one to the other plant; but as the plants grew older, some of the shoots twined regularly up a thin upright stick. Though the revolving movement was sometimes in one direction and sometimes in the other, the twining was invariably from left to right; so that the more potent or persistent movement of revolution must have been in opposition to the course of the sun. It would appear that this *Hibbertia* is adapted to ascend by twining, and to ramble laterally over the thick Australian scrub.

I have described this case in some detail, because, as far as I have seen, it is rare to find with twining plants any especial adaptations, in which respect they differ much from the more highly organized tendril-bearers. The *Solanum dulcamara*, as we shall presently see, can twine only round such stems as are both thin and flexible. Most twining plants apparently are adapted to ascend supports of different thicknesses. Our English twiners, as far as I have seen, never twine round trees, excepting the Honeysuckle (*Lonicera periclymenum*), which I have observed twining up a young beech-tree nearly 4½ inches in diameter. Mohl (S. 134) found that the *Phaseolus multiflorus* and *Ipomœa purpurea* could not, when placed in a room with the light entering on one side, twine round sticks between 3 and 4 inches in diameter; for this interfered, in a manner presently to be explained, with the revolving movement. In the open air, however, the *Phaseolus* twined round a support of the above thickness, but failed in twining round one 9 inches in diameter. Nevertheless, some twiners of the warmer temperate regions can manage this latter degree of thickness; for I hear from Dr. Hooker that at Kew the *Ruscus androgynus* ascends a column 9 inches in diameter; and although a *Wistaria* grown by me in a small pot tried in vain for weeks to get round a post between 5 and 6 inches in

thickness, yet at Kew a plant ascended a trunk above 6 inches in diameter. The tropical twiners, on the other hand, can ascend thick trees. I hear from Drs. Thomson and Hooker that this is the case with the *Butea parviflora*, one of the Menispermaceæ, and with some Dalbergias and other Leguminosæ. This power would evidently be almost necessary for twining plants inhabiting tropical forests, as otherwise they could hardly ever reach the light. In our temperate countries twining plants which die down every year to the root would suffer if they were enabled to twine round trunks of trees, for they could not grow tall enough in a single season to reach the summit and gain the light.

By what means some twining plants are adapted to ascend only thin stems, whilst others can twine round thick trees, I do not know. It appeared to me probable that twining plants with very long revolving shoots might be able to ascend thick supports; accordingly I placed *Ceropegia Gardnerii* near a post 6 inches in diameter, but the shoots entirely failed to wind round it; their length and power of movement apparently serving merely to find some distant but thin stem round which to twine. The *Sphærostemma marmoratum* is a vigorous tropical twiner, and as it is a very slow revolver, I thought that this latter circumstance might aid it in ascending a thick support; but though it was able to wind round the 6-inch post, it could do this only on the same level or plane, and could not ascend in a spire. We can, however, see, in accordance with the views previously explained, that a revolving shoot, which, after coming into contact with any support, quickly lost its power of movement, would not again be drawn away from its support by the returning or opposite movement, and therefore remaining in contact with it, might thus ascend a thick support. But whether this slight difference in retaining for some time or in quickly losing the power of movement after coming into contact with a support alone determines how thick an object the stem can ascend I do not know.

As ferns differ so much from phanerogamic plants, it may be worth while here to show that twining ferns act in no respect differently from other twining plants. In *Lygodium articulatum* the two internodes first formed above the root-stock did not move; the third from the ground revolved, and at first very slowly. This species is a slow revolver: but *L. scandens* made five revolutions at an average rate of 5 h. 45 m.; and this represents fairly well the usual rate, taking quick and slow movers, amongst phanerogamic plants. The rate was accelerated by increased temperature. The

two young upper internodes alone moved. A line painted along the surface of a revolving internode which was at the time convex, became first lateral, then concave, and ultimately convex again. Neither the internodes nor petioles are irritable when rubbed. The movement is in the more usual direction, namely in opposition to the course of the sun; and when the stem has twined round a thin stick, it becomes twisted on its own axis in the same direction. After the young internodes have twined round a stick, their continued growth causes them to slip a little upwards and onwards. If the stick be soon removed, the internodes straighten themselves, and recommence revolving. The extremities of the depending shoots turn upwards, and twine on themselves. In all these respects we have complete identity with phanerogamic twining plants; and the above enumeration may serve as a summary of the leading characteristics of common twining plants.

The power of revolving depends on the general health and vigour of the plant, as has laboriously been shown to be the case by Palm. But the movement of each separate internode is so independent of the others, that cutting off an upper one does not affect the revolutions of a lower one. When, however, Dutrochet cut off two whole shoots of the Hop, and placed them in water, the movement was greatly retarded; for one revolved in 20 h. and the other in 23 h., whereas they ought to have revolved in between 2 h. and 2 h. 30 m. Cut shoots of the Kidney-bean were similarly retarded, but in a less degree. I have repeatedly observed that carrying a plant from the greenhouse to my house, or from one to another part of the greenhouse, always stopped the movement for a time; hence I conclude that naturally exposed plants would not make their revolutions during stormy weather. A decrease in temperature always caused a considerable retardation in the rate of revolution; but Dutrochet (tom. xvii. pp. 994, 996) has given such precise observations on this head with respect to the tendril-bearing Pea that I need say nothing more. When twining plants are placed near a window in a room, the light in some cases has a remarkable power (as was likewise observed by Dutrochet, p. 998, with the Pea) on the revolving movement, but different in degree with different plants: thus *Ipomœa jucunda* (as may be seen in the table) revolved in 5 h. 20 m., the semicircle from the light taking 4 h. 30 m., and that towards the light only 1 h.; *Lonicera brachypoda* revolved, in a reversed direction to the *Ipomœa*, in 8 h., the semicircle from the light taking 5 h. 23 m., and that to the light only 2 h. 37 m. From the rate of revolution in all

the plants which I have observed being nearly the same during the night and the day, I infer that the action of the light is confined to retarding one semicircle and accelerating the other, so as not to greatly modify the whole rate. This action is remarkable when we reflect how little the leaves are developed on the young and very thin revolving internodes. It is the more remarkable, as botanists have thought (Mohl, S. 119) that twining plants are but little sensitive to the action of light.

I will conclude my account of twining plants by collecting a few miscellaneous and curious cases. With most twining plants all the branches, however many there may be, go on revolving together; but, according to Mohl (S. 4), the main stem of *Tamus elephantipes* does not twine—only the branches. On the other hand, with the Asparagus, given in the table, the leading shoot alone, and not the branches, revolved and twined; but it should be stated that the plant was not growing vigorously. My plants of *Combretum argenteum* and *C. purpureum* made numerous short healthy shoots; but they showed no signs of revolving, and I could not conceive how these plants could be climbers; but at last *C. argenteum* put forth from the lower part of one of its main branches a thin shoot, 5 or 6 feet in length, differing greatly in appearance from the previous shoots from its leaves being little developed, and this shoot revolved vigorously and twined. So that this plant produces shoots of two sorts. With *Periploca Græca* (Palm, S. 43) the uppermost shoots alone twine. *Polygonum convolvulus* twines only during the middle of the summer (Palm. S. 43, 94): plants growing vigorously in the autumn show no inclination to twine. The majority of Asclepiadaceæ are twiners; but *Asclepias nigra* only "in fertiliori solo incipit scandere sub volubili caule" (Willdenow, quoted and confirmed by Palm, S. 41). *Asclepias vincetoxicum* does not regularly twine, but only occasionally (Palm, S. 42; Mohl, S. 112) when growing under certain conditions. So it is with two species of *Ceropegia*, as I hear from Prof. Harvey, for these plants in their native dry South African home generally grow erect, from 6 inches to 2 feet in height, a very few taller specimens showing some inclination to curve; but when cultivated near Dublin, they regularly twined up sticks 5 or 6 feet in height. Most Convolvulaceæ are excellent twiners; but *Ipomæa argyræoides* in South Africa almost always grows erect and compact, from about 12 to 18 inches in height, one specimen alone in Prof. Harvey's collection showing an evident disposition to twine. Seedlings, on the other hand, raised near

Dublin twined up sticks above 8 feet in height. These facts are highly remarkable; for there can hardly be a doubt that in the dryer provinces of South Africa these plants must have propagated themselves for thousands of generations in an erect condition; and yet during this whole period they have retained the innate power of spontaneously revolving and twining, whenever their shoots become elongated under proper conditions of life. Most of the species of *Phaseolus* are twiners; but certain varieties of the *P. multiflorus* produce (Léon, p. 681) two kinds of shoots, some upright and thick, and others thin and twining. I have seen striking instances of this curious case of variability with "Fulmer's dwarf forcing-bean," on which occasionally a long twining shoot appeared.

Solanum dulcamara is one of the feeblest and poorest of twiners: it may often be seen growing as an upright bush, and when growing in the midst of a thicket merely scrambles up the branches without twining; but when, according to Dutrochet (tom. xix. p. 299), it grows near a thin and flexible support, such as the stem of a nettle, it twines round it. I placed sticks round several plants and vertical stretched strings close to others, and the strings alone were ascended by twining. We here, perhaps, see the first stage in the habit of twining; and the stem twines indifferently to the right or the left. Some other species of the genus, and of another genus, viz. *Habrothamnus*, of the same family of Solanaceæ, which are described in horticultural works as twining plants, seemed to possess this faculty in a very feeble manner. On the other hand, I suspect that with *Tecoma radicans* we have the last vestige of a lost habit: this plant belongs to a group abounding with twining and with tendril-bearing species, but it ascends by rootlets like those of the Ivy; yet I observed that the young internodes seldom remained quite stationary, but performed slight irregular movements which could hardly be accounted for by changes in the action of the light. Anyhow it need not be supposed that there would be any difficulty in the passage from a spirally twining plant to a simple root-climber; for the young internodes of *Bignonia Tweedyana* and of *Hoya carnosa* revolve and twine, and likewise emit rootlets which adhere to any fitting surface.

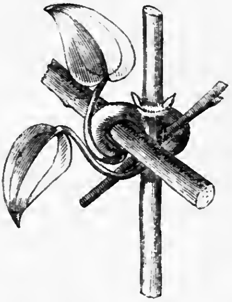
Part II.—Leaf-climbers.

It has long been observed that several plants climb by the aid of their leaves, either by the petiole or by the produced midrib; but beyond this simple fact nothing is known of them. Palm

and Mohl class these plants with those which bear tendrils; but as a leaf is generally a defined object, the present classification has, at least, some plain advantages. There are other advantages, as leaf-climbers are intermediate in many respects between twiners and certain tendril-bearing plants. I have observed eight species of *Clematis* and seven of *Tropæolum* in order to discover what amount of difference there may be within the same genus; and the differences, as we shall see, are considerable.

CLEMATIS.—*C. glandulosa.*—The thin upper internodes revolve, moving against the course of the sun, precisely like those of a true twiner, at an average rate, judging from three revolutions, of 3 h. 48 m. The leading shoot immediately twined round a stick placed near it; but, after making an open spire of only one turn and a half, it ascended for a short space straight, and then reversed its spire and wound two turns in an opposite course. This was rendered possible by the straight piece between the opposed spires having become rigid. The simple, broad, ovate leaves of this tropical species, so unlike those of most of the other species of the genus, with their short thick petioles, seem but ill-fitted for any movement. Whilst twining up a vertical stick, no use is made of them. Nevertheless, if the footstalk of a young leaf be rubbed with a thin twig a few times on any side, it will in the course of a few hours bend to that side; afterwards it becomes straight again. The under side seemed to be the most sensitive; but the sensitiveness or irritability is but slight compared to that which we shall meet with in some of the following species; for a loop of string, weighing 1·64 grain, hanging for some days on a young footstalk, produced a scarcely perceptible effect. A sketch is here given of two young leaves which had naturally caught two twigs on each side of the stem. A forked twig placed so as to lightly press on the under side of a young footstalk caused it, in 12 h., to bend greatly, and ultimately to such an extent that the leaf passed to the opposite side of the stem; the forked stick having been removed, the leaf slowly recovered its proper position.

Fig. 1.



Clematis glandulosa, with two young leaves clasping twigs, with the clasping portions thickened.

The young leaves change their position in a rather odd manner: when first developed the petioles are upturned, parallel to the stem; they then slowly bend downwards, remaining for a short time at right angles to the stem, and then become so much arched downwards that the blade of the leaf points to the ground with its tip curled inwards, so that the whole petiole and leaf together form a hook. If they come into contact with no object, they retain this position for a considerable time, and then bending upwards they reassume their original upturned position, which is retained ever afterwards. The young leaves, being hooked, are thus enabled to catch twigs when brought into contact with them by the revolving movement of the internodes. The petioles which have clasped any object soon become much thickened and strengthened, as may be seen in the diagram.

Clematis montana.—The long and thin petioles of the leaves, whilst young, are sensitive, and when lightly rubbed bend to the rubbed side, subsequently becoming straight. They are far more sensitive than the petioles of *C. glandulosa*; for a loop of thread weighing a quarter of a grain caused them to bend; a loop weighing only one-eighth of a grain sometimes acted and sometimes did not act. The sensitiveness extends to the angle between the stem and leaf-stalk. I may here state that I ascertained the weights of the string and thread used in all cases by carefully weighing 50 inches in a chemical balance, and then cutting off measured lengths*. The main petiole carries three leaflets; but the short petioles of these leaflets are not sensitive. A young inclined shoot (the plant being in the greenhouse) made a large circle opposed to the course of the sun in 4 h. 20 m., but the next day, being very cold, the time was 5 h. 10 m. A stick placed near the revolving stem was soon struck by the petioles which stand out at right angles, and the revolving movement was arrested. The petiole then began, being excited by the contact, to slowly wind round the stick. When the stick was thin, the petiole sometimes wound twice round it. The opposite leaf was in no way affected. The attitude assumed by the stem after the petiole has clasped a stick, is that of a man standing by a column, who throws his whole arm horizontally round it. With respect to the stem's power of twining, some remarks will be made under *C. calycina.*

Clematis Sieboldi.—A shoot made three revolutions against the sun at an average rate of 3 h. 11 m. The power of twining is like that of the last species. Its leaves are nearly similar, except that

* Our English grain equals nearly 65 milligrammes.

the petioles of the lateral and terminal leaflets are sensitive. A loop of thread, weighing one-eighth of a grain, acted on the main petiole; but it took between two and three days to produce any effect. The leaves have the remarkable habit and power of spontaneously revolving, generally in vertical ellipses, in the same manner, but in a less degree, as will be described under *C. microphylla.*

Clematis calycina.—The young shoots are thin and flexible; one revolved, describing a broad oval, in 5 h. 30 m., and another in 6 h. 12 m.: they followed the course of the sun; but in all the species of the genus the course followed, if observed long enough, would no doubt be found to differ. This is a rather better twiner than the two last species: the stem, when a thin upright stick free from twigs was placed near, sometimes made two spiral turns round it; then, being arrested by the clasping of the petioles, it would run up for a space straight and then generally reversed its course and took one or two spiral turns in an opposite direction. This reversal of the spire occurred in all the foregoing species. The leaves are so small compared with those of most of the other species that the petioles at first seem ill-fitted for clasping. Nevertheless the main service of the revolving movement is to bring them into contact with surrounding objects, which are slowly but securely seized. The young petioles, which alone are sensitive, have their ends bowed a little downwards, so as to be in a slight degree hooked; ultimately the whole leaf becomes flat. I gently rubbed with a thin twig the lower surfaces of two young petioles; and in 2 h. 30 m. they were slightly curved downwards; in 5 h., after being rubbed, the end of one was bent completely back parallel to the basal portion; and in 4 h. subsequently it became nearly straight again. To show how sensitive the young petioles are, I may mention that I put, in order to mark them, short streaks of water-colour on their under sides; an infinitely thin crust was thus formed, but it sufficed in 24 h. to cause both to bend downwards. Whilst the plant is young, each leaf consists of three divided leaflets, which have barely distinct petioles, and these are not then sensitive; but when the plant is well grown, the two lateral and terminal leaflets have long petioles, and these now become sensitive and are capable of clasping in any direction any object.

When the petiole has clasped a twig, it undergoes some remarkable changes, which occur with the several other species, but in a less strongly marked manner, and will be here described once for

all. The clasped petiole in the course of two or three days swells greatly, and ultimately becomes nearly twice as thick as the opposite leaf-stalk which has clasped nothing. When thin transverse slices of the two are placed under the microscope their difference is conspicuous: the side of the footstalk which has been in contact with the support is formed of a layer of colourless cells with their longer axes directed from the centre of the petiole, and very much larger than any cells found in the opposite or unchanged petiole; the central cells, also, are in some degree enlarged, and the whole is much indurated. The exterior surface generally becomes bright red. But a far greater change takes place in the nature of the tissues than that which is externally visible: the petiole of the unclasped leaf is flexible, and can be easily snapped, whereas the clasped footstalk acquires an extraordinary toughness and rigidity, so that considerable force is required to pull it into pieces. With this change, great durability is probably acquired; at least this is the case with the clasped petioles of *Clematis vitalba.* The meaning of these changes is plain, namely, that the petioles may firmly and durably support the stem.

Clematis microphylla, var. *leptophylla.*—The long and thin internodes of this Australian species revolve sometimes in one direction and sometimes in an opposite one, describing long, narrow, irregular ellipses or large circles: four revolutions were completed within five minutes of the same average rate of 1 h. 51 m.; so that this species moves more quickly than any other of the genus. The shoots, when placed near a vertical stick, either twine round it or clasp it with the basal portions of their petioles. The leaves whilst young are nearly of the same general shape, and act in the same manner like a hook, as will be described under *C. viticella*; but the leaflets are more divided, as in *C. calycina,* and each segment whilst young terminates in a hardish point, and is much curved downwards and inwards; so that the whole leaf readily catches and becomes entangled with any neighbouring object. The petioles of the young terminal leaflets are acted on by loops of thread weighing $\frac{1}{8}$th and $\frac{1}{16}$th of a grain: the basal portion of the main petiole is much less sensitive, but will clasp a stick against which it presses.

The whole leaf, whilst young, is in continual, spontaneous, slow movement. The stem was secured close to the base of the leaves, and, a bell-glass being placed over the shoot, the movements of the leaves were traced on it during several days. A very irre-

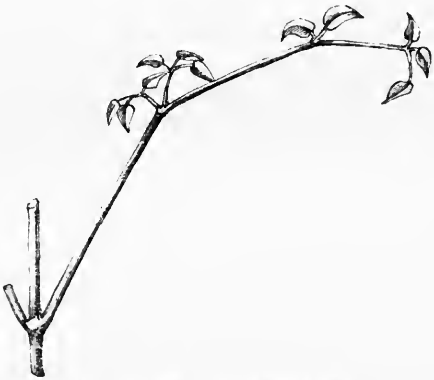
gular line was generally formed; but one day, in the course of eight hours and three quarters, the figure traced, clearly represented three and a half irregular ellipses, the most perfect one of which was completed in 2 h. 35 m. The two opposite leaves moved quite independently of each other. This movement would aid that of the internodes in bringing the petioles into contact with surrounding objects. I discovered this spontaneous movement too late to be enabled to observe the leaves in all the other species; but from analogy I can hardly doubt that the leaves of at least *C. viticella*, *C. flammula*, and *C. vitalba* move spontaneously; and, judging from *C. Sieboldi*, this probably is the case with *C. montana* and *C. calycina*. I ascertained that the simple leaves of *C. glandulosa* exhibited no spontaneous revolving movement.

Clematis viticella, var. *venosa*.—In this and the two following species the power of spirally twining is completely lost, and this seems due to the lessened flexibility of the internodes and to the interference caused by the large size of the leaves. But the revolving movement, though restricted, is not lost. In our present species a young internode, placed in front of a window, made three narrow ellipses, transversely to the light, at an average rate of 2 h. 40 m.; when placed so that the movement was to and from the light, the rate was greatly accelerated and retarded, as in the case of twining plants. The ellipses were small; the longer diameter, described by the apex of a shoot bearing a pair of not expanded leaves, being only $4\frac{5}{8}$ inches, and that by the apex of the penultimate internode only $1\frac{1}{8}$ inch; at the most favourable period of growth each leaf would hardly be carried to and fro by the movement of the internodes more than two or three inches, but, as above stated, it is probable that the leaves themselves move spontaneously. The movement of the whole shoot by the wind and by its rapid growth would probably be almost equally efficient with the spontaneous movements in bringing the petioles into contact with surrounding objects.

The leaves are of large size. There are three pairs of lateral leaflets and a terminal one, all borne by rather long petioles. The main petiole bends a little angularly downwards at each point where a pair of leaflets arises, and the petiole of the terminal leaflet is bent downwards at right angles; hence the whole petiole, with its rectangularly bent extremity, acts as a hook. This, with the lateral petioles directed a little upwards, forms an excellent grappling apparatus by which the leaves readily become entangled with surrounding objects. If they catch nothing, the

whole petiole ultimately grows straight. Both the medial and lateral petioles are sensitive; and the three branches, into which the basi-lateral petioles are generally subdivided, likewise are sensitive. The basal portion of the main petiole between the stem and the first pair of leaflets is less sensitive than the remainder, but it will clasp a stick when in contact. On the other hand, the

Fig. 2.



A young leaf of *Clematis viticella*.

inferior surface of the rectangularly bent terminal portion (carrying the terminal leaflet), which forms the inner side of the end of the hook, is the most sensitive part; and this portion is manifestly best adapted to catch distant supports. To show the difference in sensibility, I gently placed loops of string of the same weight (in one instance weighing ·82 of a grain) on the several lateral and on the terminal sub-petioles; in a few hours the latter were bent, but after 24 h. no effect was produced on any of the lateral petioles. Again, a terminal sub-petiole placed in contact with a thin stick became sensibly curved in 45 m., and in 1 h. 10 m. had moved through ninety degrees, whereas a lateral petiole did not become sensibly curved until 3 h. 30 m. had elapsed. In this latter case, and in all other such cases, if the sticks be taken away, the petioles continue to move during many hours afterwards; so they do after a slight rubbing; but ultimately, if the flexure has not been very great or long-continued, they become, after about a day's interval, straight again.

The gradation in the extension of the sensitiveness in the petioles of the several above-described species deserves notice. In *C. montana* it is confined to the main petiole, and has not spread to the sub-petioles of the three leaflets; so it is with young plants

of *C. calycina*; but in older plants it has spread to the three sub-petioles. In *C. viticella* it has spread to the petioles of the seven leaflets, and to the subdivisions of the basi-lateral sub-petioles. In this latter species the sensitiveness has diminished in the basal part of the main petiole, in which alone it resided in *C. montana*, and has accumulated in the abruptly bent terminal portion.

Clematis flammula.—The shoots, which are rather thick, straight, and stiff, whilst growing vigorously in the spring, made small oval revolutions, following the sun in their course. Four were made at an average rate of 3 h. 45 m. The longer axis of the oval, described by the extreme tip, was directed at right angles to the line joining the opposite leaves; its length was in one case only $1\frac{3}{8}$, and in another case $1\frac{6}{8}$ inch; so that the young leaves are moved a very short distance. The shoots of the same plant observed in midsummer, when growing not so quickly, did not revolve at all. I cut down another plant in the early summer, so that by August 1st it had formed new and moderately vigorous shoots; these, when observed under a bell-glass, were on some days quite stationary, and on other days moved to and fro only about the eighth of an inch. Consequently the revolving power is here much enfeebled, and under unfavourable circumstances is completely lost. This species must depend on the probable, though not ascertained, spontaneous movements of its leaves, on the rapid growth of its shoots, and on movements from the wind, for coming into contact with surrounding objects: hence, perhaps, it is that the petioles have acquired, as we shall see, in compensation a high degree of sensitiveness.

The petioles are bowed downwards, and have the same general hook-like form as in *C. viticella.* The medial petiole and lateral sub-petioles are sensitive, especially the much-bent terminal portion. As the sensitiveness is here greater than in any other species of the genus observed by me, and is in itself remarkable, I will give fuller details. The petioles, when so young that they have not separated from each other, are not sensitive; when the lamina of a leaflet has grown to quarter of an inch in length (that is, about one-sixth of its full size), the sensitiveness is highest; but at this period the petioles are much more fully developed proportionally than the laminæ of the leaves. Full-grown petioles are not in the least sensitive. A thin stick placed so as to press lightly against a petiole, bearing a leaflet a quarter of an inch in length, caused the petiole to bend in 3 h. 15 m.; in another case a petiole curled completely round a stick in 12 h. These petioles

were left curled for 24 h., and then the sticks were removed; but they never straightened themselves. I took a twig, thinner than the petiole itself, and lightly rubbed with it several petioles four times up and down; these in 1 h. 45 m. became slightly curled; the curvature increased during some hours and then began to decrease, but after 25 h. from the time of rubbing a vestige of the curvature remained. Some other petioles similarly rubbed once up and down became perceptibly curved in about 2 h. 30 m., a terminal sub-petiole moving more than a lateral sub-petiole; they became quite straight again in between 12 h. and 14 h. Lastly, a length of about one-eighth of an inch of a sub-petiole, lightly rubbed with the same twig only once down, became slightly curved in 3 h., and remained so during 11 h., but the next morning was quite straight.

The following observations are more precise. After finding that heavier pieces of string and thread acted, I placed a loop of string, weighing 1·04 gr., on a terminal petiole: in 6 h. 40 m. a curvature could be seen; in 24 h. the petiole formed an open ring round the string; in 48 h. the ring had almost closed on the string, and in 72 h. it had firmly seized the fine twine so that it required some force to withdraw it. A loop weighing ·52 of a grain caused a *lateral* sub-petiole just perceptibly to curve in 14 h., but after 24 h. it had moved through ninety degrees. These observations were made during the summer: the following were made in the spring, when the petioles are apparently more sensitive:—A loop of thread, weighing one-eighth of a grain, produced no effect on the lateral sub-petioles, but placed on a terminal one caused, after 24 h., a moderate curvature in it; the curvature, though the loop remained suspended, was after 48 h. diminished, but never disappeared, showing that the petiole had become partially accustomed to the insufficient stimulus. This experiment was twice repeated with nearly similar results. Lastly, a loop of thread, weighing only one-sixteenth of a grain (nearly equal to four milligrammes), was twice gently placed by a forceps on a terminal sub-petiole (the plant being, of course, in a still and closed room), and this weight certainly caused a flexure, which very slowly increased until the petiole had moved through nearly ninety degrees: beyond this it did not move; nor did the petiole, the loop remaining suspended, ever become perfectly straight again.

When we consider, on the one hand, the thickness and stiffness of the petioles, and, on the other hand, the thinness and softness of fine cotton thread, and what an extremely small weight one-

sixteenth of a grain is, these facts are remarkable. But I have reason to believe that even a less weight causes a curvature when acting over a broader surface than can be affected by thin thread. Having noticed that the tail of a suspended string, which accidentally touched a petiole, had caused it to bend, I took two pieces of thin twine, 10 inches in length (weighing 1·64 gr.), and, tying them to a stick, let them hang as nearly perpendicularly downwards as their thinness and flexuous nature, after being stretched, would permit; I then quietly placed their ends so as just to rest on two petioles with their tips hanging about the tenth of an inch beneath; both these petioles certainly became curved in 36 h. One of the ends of string, which just touched the angle between a terminal and lateral sub-petiole, was in 48 h. caught as by a forceps between them. In these cases the pressure, though spread over a wider surface than that touched by the cotton thread, must have been excessively slight.

Clematis vitalba.—My plants in pots were not healthy; so that I dare not trust my observations, which indicated much similarity in habits with *C. flammula.* I mention this species only because I saw many proofs that the petioles of plants growing naturally are excited to movement by very slight pressure. For instance, I found petioles which had clasped thin withered blades of grass, the soft young leaves of a maple, and the lateral flower-peduncles of the quaking-grass or Briza: the latter are only about as thick as a hair from a man's beard, but they were completely surrounded and clasped. The petioles of a leaf, so young that none of the leaflets had expanded, had partially seized on a twig. The petioles of almost every old leaf, even when unattached to any object, are much convoluted; but this is owing to their having come, whilst young, into contact during several hours with some object subsequently removed. With the several above-described species, cultivated in pots and thus carefully observed, there never was any bending of the petioles without the stimulus of contact. When winter comes on, the blades of the leaves of *C. vitalba* drop off; but the petioles (as was also observed by Mohl) remain, sometimes during two seasons, attached to the branches; and, being convoluted, they curiously resemble true tendrils, such as those occurring in the allied genus *Naravelia.* The petioles which have clasped an object become much more woody, stiff, hard, and polished than those which have failed in this their proper purpose.

TROPÆOLUM.—I observed *T. tricolorum*, *T. azureum*, *T. penta-*

phyllum, *T. peregrinum*, *T. elegans*, *T. tuberosum*, and a dwarf variety of, as I believe, *T. minus*.

Tropæolum tricolorum, var. *grandiflorum*.—The flexible shoot, which first rises from the tuber, is as thin as thin twine. One such shoot revolved in a course opposed to the sun, at an average rate, judging from three revolutions, of 1 h. 23 m.; but no doubt the direction of the revolving movement is variable. When the plant had grown tall and much branched, all the many lateral shoots continued to revolve. The stem, whilst young, twined regularly round a thin vertical stick; in one case I counted eight spiral turns: but when grown older, the stem often runs straight up for a space, and, being arrested by the clasping petioles, makes one or two spires in a reversed direction. Until the plant has grown to a height of two or three feet, about a month after the first shoot has appeared above ground, no true leaves, but in their place little filaments, coloured like the stem, are produced. The extremities of these filaments are pointed, a little flattened, and furrowed on the upper surface. They never become developed into leaves. As the plant grows in height new filaments are produced with slightly enlarged tips; then others, bearing on each side of the enlarged medial tip a rudimentary segment of a leaf; and soon other segments appear, until a perfect leaf is formed with seven deep segments. So that on the same plant we may see every step from tendril-like filaments to perfect leaves. Hence this plant, whilst young, might be classed with tendril-bearers. After the plant has grown to a considerable height, and is secured to its support by the clasping petioles of the true leaves, the clasping filaments on the lower part of the stem wither and drop off; so that they perform only a temporary service.

These filaments, as well as the petioles of the perfect leaves, whilst young, are highly sensitive on all sides to a touch. The slightest rub causes them to curve towards the rubbed side in about three minutes: one bent itself into a ring in six minutes; they subsequently became straight again: if, however, they have once completely clasped a stick, when this is removed, they do not recover themselves. The most remarkable fact, and which I have observed in no other species of the genus, is that the filaments and petioles of the young leaves, if they catch no object, after standing in their original position for some days spontaneously and slowly move, oscillating a little from side to side, towards the stem of the plant. Hence all the petioles and filaments, though arising on different sides of the axis, ultimately bend towards and

clasp either their own stem or the supporting stick. The petioles and filaments often become, after a time, in some degree spirally contracted. In these spontaneous movements, and in the abortion of their laminæ, the sensitive filaments present a much nearer approach to the condition of tendrils than do the petioles of any other leaf-climber observed by me.

Tropæolum azureum.—An upper internode made four revolutions, following the sun, at an average rate of 1 h. 47 m. The stem twined spirally in the same irregular manner as in the last species; it produced no filaments or rudimentary leaves. The petioles of the young leaves are very sensitive: a single very light rub with a twig caused one to move perceptibly in 5 m., and another in 6 m.; the former petiole became bent at right angles in 15 m., and became straight again in between 5 h. and 6 h. A loop of thread weighing $\frac{1}{8}$th of a grain caused a petiole to curve.

Tropæolum pentaphyllum.—The plant observed by me had not the power of spirally twining, which seemed due, not to the want of flexibility in the stem, but rather to continual interference from the clasping petioles. An upper internode made three revolutions, following the sun, at an average rate of 1 h. 46 m. The main purpose of the revolving movement in all the species is manifestly to bring the petioles into contact with some supporting object. The petiole of a young leaf, after a slight rub, became curved in 6 m.; another, on a cold day, in 20 m.; but others generally in from 8 m. to 10 m.: the curvature usually increased greatly in from 15 m. to 20 m. The petioles became straight again in between 5 h. and 6 h., and on one occasion in 3 h. When a petiole had fairly clasped a stick, it could not on the removal of the stick recover itself; but the free upper part of a petiole, which had already clasped a stick by its basal part, still had the power of movement. A loop of thread weighing $\frac{1}{8}$th of a grain certainly caused a petiole to curve; but the stimulus was not sufficient, the loop remaining suspended, to cause a permanent flexure. If a much heavier loop be placed in the angle between the petiole and the stem, it produces no effect; whereas we have seen that the angle between the stem and petiole of *Clematis montana* is sensitive.

Tropæolum peregrinum.—In a very young plant the internodes did not revolve, resembling in this respect a young twining plant. The four upper internodes in an older plant made three irregular revolutions, in a course opposed to the sun, at an average rate of 1 h. 48 m. It is remarkable how nearly the same the average rate of revolution (taken, however, but from few

observations) is in this and the two last species, namely, 1 h. 47 m., 1 h. 46 m, and 1 h. 48 m. The present species cannot spirally twine, which seems mainly due to the rigidity of its stem. In a very young plant, which did not revolve, the petioles were not sensitive. In older plants the petioles of quite young leaves, and of leaves as much as an inch and a quarter in diameter, are sensitive. A moderate rub caused one to curve in 10 m., but others in 20 m.; the petioles became straight again in from 5 h. 45 m. to 8 h. Petioles which have naturally come into contact with a stick, sometimes take two turns round it. When clasped round a support, they become rigid and hard. The petioles are less sensitive to a weight than in the previous species; for loops of string weighing ·82 of a grain did not cause any curvature, whilst a loop of double this weight (1·64 gr.) did act.

Tropæolum elegans.—I did not make many observations on this species. The short and stiff internodes revolve irregularly, and describe extremely small oval figures; one was completed in 3 h. A young petiole, when rubbed, became slightly curved in 17 m.; then much more so; and was nearly straight again in 8 h.

Tropæolum tuberosum.—The internodes on a plant nine inches high did not move at all; but on an older plant they moved irregularly, and made very small imperfect ovals. These movements could be detected only by being traced on a bell-glass placed over the plant. Sometimes the shoots stood still for hours; during some days they moved only in one direction in a crooked line; on other days they made small irregular spires or circles, one being completed in about 4 h. The movement of the apex of the shoot, from extreme point to point of the oval, was only about one inch or one and a half; yet this slight movement brought the petioles into contact with closely surrounding twigs, which were then clasped. With the lessened power of spontaneously revolving, compared with the previous species, the sensitiveness of the petioles is likewise diminished. These, when rubbed a few times, did not become curved until half an hour had elapsed; the curvature increased during the next two hours, and then very slowly decreased; so that the petioles sometimes required 24 h. to become straight again. The petioles of very young leaves can act perfectly; one with the lamina only ·15 of an inch in diameter, that is, about a twentieth of the full size, firmly clasped a thin twig: but leaves grown to one quarter of their full size can likewise act.

Tropæolum minus (?).—The internodes of a variety named

"dwarf crimson Nasturtium" had no power of revolving; but they moved during the day to the light, and from it at night, in a rather irregular course. The petioles, when well rubbed, showed no power of curving; nor could I see that they ever clasped any neighbouring support. We have seen in this genus a gradation from species such as *T. tricolorum*, which have exquisitely sensitive petioles, and internodes which have rapid revolving powers and can spirally twine up a support, to other species, such as *T. elegans* and *T. tuberosum*, the petioles of which are much less sensitive, and the internodes of which have very feeble revolving powers and cannot spirally twine round a support, to this last species, which has entirely lost or never acquired these faculties. From the general character of the genus, the loss of power seems the more probable alternative.

In this species and in *T. elegans*, and probably in others, the flower-peduncles, as soon as the seed-capsule begins to swell, spontaneously bend abruptly downwards and become somewhat convoluted: when a stick lies in the path, it is to a certain extent clasped; but, as far as I have been able to observe, the movement of the peduncle is quite independent of the stimulus from contact.

ANTIRRHINEÆ.—In this tribe (Lindley) of the Scrophulariaceæ, at least four of the seven included genera have leaf-climbing species.

Maurandia Barclayana.—A thin, slightly bowed shoot made two revolutions, following the sun, each in 3 h. 17 m.; this same shoot, the day before, revolved in an opposite direction. The shoots do not spirally twine, but climb excellently by the aid of the young sensitive petioles. These petioles, when lightly rubbed, move after a considerable interval of time, and subsequently become straight again; a loop of thread weighing $\frac{1}{8}$th of a grain caused them to bend.

Maurandia semperflorens.—This freely growing species climbs exactly like the last, by its sensitive petioles. A young internode made two circles, each in 1 h. 46 m.; so that it moves almost twice as rapidly as the last species. But I should not have noticed the present species, had it not been for the following unique case. Mohl says (S. 45) that "the flower-peduncles, as well as the petioles, are wound into tendrils;" and he adds nothing more about the genus. But it must be observed that Mohl classes as tendrils even such objects as the spiral flower-stalks of the *Vallisneria*. Nevertheless this remark, and the well-known fact that the flower-peduncles of this *Maurandia* are flexuous, led me care-

fully to examine them. They never act as tendrils: I repeatedly placed thin sticks in contact with young and old peduncles, and I allowed nine vigorous plants to grow over an entangled mass of branches; but in no one instance did a peduncle bend round any object. It is indeed in the highest degree improbable that this should occur, for the flower-peduncles are generally developed on branches which have already securely clasped a support by their petioles; and when borne on free depending branches, they are not produced by the terminal portion of the internode which alone has the power of revolving; so that they can only accidentally and rarely be brought into contact with any surrounding object. Nevertheless (and this is the remarkable fact) these flower-peduncles, whilst young, exhibit feeble revolving powers, and are slightly sensitive to a touch. I selected some stems which had firmly clasped a stick by their petioles, and, placing a bell-glass over them, traced the movements of the young flower-peduncles. Some days these moved over a short and extremely irregular line, making little loops in their course. One day a young peduncle $1\frac{1}{2}$ inch in extreme length was carefully observed, and it made four and a half narrow, vertical, irregular, and very short ellipses—each at an average rate of about 2 h. 25 m.; an adjoining peduncle described during the same time similar, but fewer, ellipses. As the plant had for some time occupied exactly the same position, these movements could not be attributed to the varying action of the light. Peduncles, old enough for the coloured petals to be just visible, do not move. With respect to irritability, I rubbed a few times very lightly with a thin twig two young peduncles ($1\frac{1}{2}$ inch in length), one on the upper side and the other on the lower side, and they became in between 4 h. and 5 h. plainly bowed towards the rubbed sides; in 24 h. subsequently, they straightened themselves. Next day they were rubbed on the opposite sides, and they became perceptibly curved towards these sides. Two other and younger peduncles (three-fourths of an inch in length) were lightly rubbed on their adjoining sides, and they became so much bowed towards each other, that the arcs of the bows stood at nearly right angles to their previous positions; this was the greatest movement seen by me; subsequently they straightened themselves. Other peduncles, so young as to be only three-tenths of an inch in length, became curved when rubbed. On the other hand, peduncles above $1\frac{1}{2}$ inch in length required to be rubbed two or three times, and then became only just perceptibly curved. Loops of thread suspended on the peduncles pro-

duced no effect; but loops of string weighing ·82 and 1·64 grain acted capriciously, sometimes causing a slight curvature; but they were never clasped, like the far lighter loops of thread by the petioles.

In the nine vigorous plants which I observed, it is certain that neither the slight spontaneous movements nor the slight sensitiveness of the flower-peduncles were of any service to the plants in climbing. If any member of the Scrophulariaceæ had been known to have flower-peduncles used for climbing, or had tendrils produced by their modification, I should have thought that this *Maurandia* still retained a useless or rudimentary vestige of a former habit; but this view cannot be maintained. We are almost compelled to believe that by some correlation of growth the power of movement has been transferred from the young internodes to the young peduncles, and in the same manner sensitiveness from the young petioles to the young peduncles; but this latter supposition is the more improbable, as I could detect no sensitiveness in the young internodes of the *Maurandia*, though in a closely allied genus, *Lophospermum*, the young internodes, as we shall see, are sensitive. By whatever means the peduncles of this *Maurandia* have acquired their power of spontaneous movement and their sensitiveness, the case is interesting for us; for we can see that if these now useless capacities were a little perfected, the flower-peduncles could be made as useful for climbing as are the flower-peduncles of *Vitis* and *Cardiospermum*, as will hereafter be described.

Rhodochiton volubile.—A long flexible shoot swept a large circle, following the sun, in 5 h. 30 m.; and, as the day became warmer, a second circle in 4 h. 10 m. The shoots sometimes make a whole or half spire round a vertical stick, then run up for a space straight, and afterwards make spiral turns in an opposite direction. The petioles of very young leaves, about one-tenth of their full size, are highly sensitive, and bend towards any side which has been touched; but they do not move quickly: one, after being lightly rubbed, was perceptibly curved in 1 h. 10 m., and became considerably arched in 5 h. 40 m. after the rubbing; some other petioles, after being rubbed, were scarcely curved in 5 h. 30 m., but in 6 h. 30 m. were distinctly curved. A curvature was perceptible in a petiole in between 4 h. 30 m. and 5 h., after the suspension of a little loop of string. A loop of fine cotton thread, weighing one-sixteenth of a grain, not only slowly caused a petiole to bend, but was ultimately firmly clasped by it, so that it could be withdrawn only by

some little force. The petioles, when coming into contact with a stick, take either a complete or half turn round it; ultimately they increase much in thickness. Leaves arising on the side of the stem opposite to the light move towards it; and, in doing so, the petioles are sometimes brought into contact with the stem, and consequently clasp it; but the petioles have no true spontaneous movement.

Lophospermum scandens, var. *purpureum*.—Some long, moderately thin internodes made four revolutions at an average rate of 3 h. 15 m. The course pursued was very irregular—sometimes an extremely narrow ellipse, sometimes a large circle, sometimes an irregular spire or zigzag line, and sometimes the apex stood still. The young petioles, when brought by the revolving movement into contact with a stick, clasp it, and soon increase considerably in thickness; but they are not quite so sensitive to a light weight as those of the *Rhodochiton*, for loops of thread weighing one-eighth of a grain did not invariably cause them to bend.

This plant presents a case not observed in any other leaf-climber or twiner or tendril-bearer, or in any other plant as far as I know, namely, that the young internodes are sensitive to a touch. When a petiole clasps a stick, it draws the base of the internode against it; and then the internode itself bends towards the stick, which is thus caught between the stem and the petiole as by a pair of pincers. The internode straightens itself again, excepting the part in contact with the stick. Young internodes alone are sensitive, and these are sensitive on all sides along their whole length. I made fifteen trials by lightly rubbing two or three times with a thin twig several internodes; and in about 2 h., but in one case in 3 h., all became bent: they became straight again in about 4 h., subsequently. An internode, which was rubbed as much as six or seven times with a twig, became just perceptibly curved in 1 h. 15 m., and subsequently in 3 h. the curvature increased much; the internode became straight again in the course of the night. I rubbed some internodes one day on one side, and the next day on the opposite side or at right angles; and the curvature was always towards the rubbed side.

According to Palm (S. 63), the petioles of *Linaria cirrhosa* and, to a limited degree, those of *L. elatine* have the power of clasping a support.

Solanum.—*S. jasminoides*.—Some of the species of this large genus are twiners; but this is a true leaf-climber. A long, nearly upright shoot made four revolutions, moving against the sun, very

regularly at an average rate of 3 h. 26 m. The shoots, however, sometimes stand still. It is considered a greenhouse plant; but when kept there, the petioles took several days to clasp a stick: in the hothouse a stick was clasped in 7 h. In the greenhouse a

Fig. 3.

Solanum jasminoides, with one of its leaves clasping a stick.

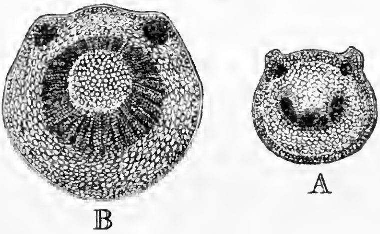
petiole was not affected by a loop of string, suspended during several days and weighing 2½ grains; in the hothouse one was made to curve by a loop weighing 1·64 (and, on the removal of the string, became straight again), but was not at all affected by another loop weighing ·82 of a grain. We have seen that the petioles of some other leaf-climbing plants were affected by one-thirteenth of this latter weight. In this plant, and in no other leaf-climber seen by me, a leaf grown to its full size was capable of clasping a stick; but the movement was so extraordinarily slow that in the greenhouse the act required several weeks; but on each succeeding week it was clear that the petiole became more and more curved, until finally it firmly clasped the stick.

When the flexible petiole of a half- or a quarter-grown leaf has clasped any object, in three or four days it increases much in thickness, and after several weeks becomes wonderfully hard and rigid; so that I could hardly remove one from its support. On comparing a thin transverse slice of this petiole with one from the next or older leaf beneath, which had not clasped anything, its diameter was found to be fully doubled, and its structure greatly changed. In two other petioles similarly compared, and

here represented, the increase in diameter was not quite so great. In the section of the petiole in its ordinary state (A), we see a

Fig. 4.

Solanum jasminoides.



A. Section of a petiole.
B. Section of a petiole some weeks after it had clasped a stick, as shown in fig. 3.

semilunar band of cellular tissue slightly different from that outside it, and including three closely approximate groups of dark vessels. Near the upper surface of the petiole, beneath two ridges, there are two other small circular groups of vessels. In the section of the petiole (B) which had during several weeks clasped a stick, the two upper ridges have become much less prominent, and the two groups of woody vessels beneath them much increased in diameter. The semilunar band is converted into a complete ring of very hard, white, woody tissue, with lines radiating from the centre. The three groups of vessels, which, though closely approximate, were before distinct, are now completely blended together. The upper part of the new ring of woody vessels, formed by the prolongation of the horns of the original semilunar band, is thinner than the lower part, and is slightly different in appearance from being less compact. This clasped petiole had actually become thicker than the stem close beneath; and this was chiefly due to the greater thickness of the ring of wood, which presented, both in transverse and longitudinal sections, a closely similar structure in the petiole and axis. The assumption by a petiole of this structure is a singular morphological fact; but it is a still more singular physiological fact that so great a change should have been induced by the mere act of clasping a support *.

FUMARIACEÆ.—*Fumaria officinalis.*—It could not have been

* Dr. Maxwell Masters informs me that in most, or all, petioles which are cylindrical, such as those bearing peltate leaves, the woody vessels form a closed ring, and that the semilunar band of vessels is confined to petioles which are channelled along their upper surfaces. In accordance with this statement, it

anticipated that so lowly a plant would have been a climber. This it effects by the aid of the main and lateral petioles of its compound leaves; even the much-flattened terminal portion of the petiole can seize a support. I have seen a substance as soft as a withered blade of grass caught. Petioles which have clasped any object ultimately became rather thicker and more cylindrical. On lightly rubbing with a twig several petioles, they became perceptibly curved in 1 h. 15 m., and subsequently they straightened themselves. A stick gently placed in the angle between two sub-petioles caused movement in 7 h., and was almost clasped in 9 h. A loop of thread, weighing one-eighth of a grain, caused, after 12 h. and before 20 h. had elapsed, a considerable curvature; but the petiole never fairly clasped the thread. The young internodes are in continual movement; the movement is considerable, but very irregular in course; a zigzag line, or a spire crossing itself, or a figure of 8 is formed; the course during 12 h., being traced on a bell-glass, apparently represented about four ellipses. The leaves themselves also move spontaneously, the main petiole curving itself in accordance with the movement of the internodes; so that when the latter move to one side the petiole is curved to that side, then, becoming straight, is curved to the opposite side. Thus a wider space is swept for a support to be clasped. The movement, however, is small, as could be seen when the shoot was securely tied to a stick and the leaf alone allowed to move. The leaf in this case followed an irregular course, like that made by the young internodes.

Adlumia cirrhosa.—I raised some plants late in the summer; they formed magnificent leaves, but threw up no central stem. The first-formed leaves were not sensitive; but some of the later leaves were sensitive, but only towards their extremities, and were able to clasp sticks. This could be of no service to the plant, as these leaves rose from the ground; but it showed what the future character of the plant would be when it had grown tall enough to climb. The tip of one of these ground leaves, whilst young, described in 1 h. 36 m. a narrow ellipse, open at one end, and exactly three inches in length; a second ellipse was broader, more irregular, and shorter, viz. only 2½ inches in length, and was completed in 2 h. 2 m. From analogy with *Fumaria* and *Corydalis*, I have no doubt that the internodes have the power of revolving.

may be observed that the enlarged and clasped petiole of the *Solanum*, with its closed ring of woody vessels, has become much more cylindrical than it was in its original unclasped condition.

Corydalis claviculata.—This plant is interesting from being in a condition so exactly intermediate between a leaf-climber and a tendril-bearer that it might have been described under either head; but, for reasons hereafter assigned, it is classed amongst tendril-bearers.

Besides the plants already described, *Bignonia unguis* and its close allies, though aided by tendrils, as will hereafter be described, have clasping petioles. According to Mohl (S. 40), *Cocculus Japonicus* (one of the Menispermaceæ) and a fern, the *Ophioglossum Japonicum* (S. 39), climb by their leaf-stalks.

We now come to a small section of plants which climb by the aid of the produced midribs or tips of their leaves.

GLORIOSA.—*G. Plantii* (Liliaceæ).—The stem of a half-grown plant continually moved, generally describing an irregular spire, but sometimes ovals, with the longer axes running in different directions. It either followed the sun, or moved in an opposite course, and sometimes stood still before reversing its course. One oval was completed in 3 h. 40 m.; of two horseshoe-shaped figures, one was completed in 4 h. 35 m. and the other in 3 h. The tip of the shoot, in its movements, reached points between four and five inches asunder. The young leaves, when first developed, stand up nearly vertically; but by the growth of the axis, and by the spontaneous bending down of the terminal half of the leaf, they soon become much inclined, and ultimately horizontal. The end of the leaf forms a narrow, ribbon-like, thickened projection, which at first is nearly straight; but by the time the leaf has got into an inclined position, the end has bent itself downwards into a well-formed hook; and this is now strong and rigid enough to catch any object, and, when caught, to anchor the plant and stop the revolving movement. This hook is sensitive on its inner surface, but not in nearly so high a degree as with the many before-described petioles; for a loop of string, weighing 1·64 grain, produced no effect. When the hook has caught a thin twig or even a rigid fibre, the point may be perceived in from 1 h. to 3 h. to have curled a little inwards; and, under favourable circumstances, in from 8 h. to 10 h. it finally curls round and seizes the object, which it never again looses. The hook when first formed, before the leaf has become inclined, is less sensitive. The hook, if it catches hold of nothing, remains for a long period open and sensitive; ultimately the tip spontaneously and slowly curls inwards, and makes a button-like, flat, spiral coil at the end of the leaf. One leaf was

watched, and the hook remained open for thirty-three days; but during the last week the tip had curled inwards so much that at last only a very thin twig could have been inserted. As soon as the curling-in of the tip has closed the hook and converted it into a ring, its sensibility, both within and without, is lost; but as long as the hook remains open its sensibility is retained.

When the plant had grown from the bulb to the height of only about six inches, the leaves, four or five in number, were broader than those subsequently produced, and their soft and but little-attenuated tips did not form hooks, and were not sensitive; nor did the stem revolve. At this early period of growth, the plant can support itself; its climbing apparatus is not required, and therefore is not acquired. On the other hand, a full-grown plant which was flowering, and which would not have grown any taller, had leaves on the summit, which were not sensitive, and could not clasp a stick.

Flagellaria Indica (Commelynaceæ).—From dried specimens it is manifest that this plant climbs exactly like *Gloriosa*. A young plant, 12 inches in height, and bearing fifteen leaves, had not one leaf as yet produced into a hook or tendril-like filament; nor did the stem revolve. Hence this plant acquires its climbing power later in life than the *Gloriosa* lily. According to Mohl (S. 41), *Uvularia* (Melanthaceæ) climbs like *Gloriosa*.

These three last-named genera are all Monocotyledons; but there is one Dicotyledon, namely *Nepenthes*, which is ranked by Mohl (S. 41) amongst tendril-bearers; and I hear from Dr. Hooker that most of the species climb well at Kew. This is effected by the stalk or midrib between the leaf and the pitcher twisting round any support. The twisted part becomes thicker; but I observed at Mr. Veitch's that the stalk often takes a turn when not in contact with any object, and that this twisted part likewise becomes thickened. Two vigorous young plants of *N. lævis* and *N. distillatoria*, in my hothouse, whilst less than a foot in height, showed no sensitiveness in their leaves or power of movement or of climbing. But when *N. lævis* had grown to a height of 16 inches, there were signs of these powers. Each young leaf when first formed stands upright, but soon becomes inclined; at this period of growth it terminates in a stalk or filament, with the pitcher at the extremity so little developed that this part is not thicker than any other part. The leaf in this state certainly exhibited slight spontaneous movements; and when the stalk came into contact with a stick, it very slowly bent round and firmly seized it. But

the leaf by its subsequent growth became quite slack, though the terminal stalk remained coiled round the stick; hence it would appear that the chief use of the coiling, at least whilst the plant is young, is to support the pitcher with its load of secreted fluid.

Summary on Leaf-climbers.—Plants belonging to eight families are known to have clasping petioles, and plants belonging to four families climb by the tips of their leaves. With all the plants observed by me, the young internodes revolved more or less regularly, in some cases as regularly as does any twining plant, and at various rates, but generally rather rapidly. Some few can ascend by twining spirally round a support. Differently from most twiners, there is a strong tendency in the same shoot to revolve first in one and then in the opposite direction. The object gained by the revolving movement, as could be plainly seen, was to bring the petioles or the tips of the leaves into contact with surrounding objects; without this aid there would be a poor chance of success. With rare exceptions, the petioles are sensitive only whilst young; they are sensitive on all sides, but in different degrees in different plants, and in some species of *Clematis* in very different degrees in different parts of the same petiole. The hooked tips of the leaves of the *Gloriosa* are sensitive only on their inner or inferior surface. The petioles are sensitive to a touch and to excessively slight continued pressure, even from a loop of soft thread weighing only the one-sixteenth of a grain; and there is reason to believe that the rather thick and stiff petioles of *Clematis flammula* are sensitive to even a less weight when spread over a wider surface. The petioles always bend towards the touched or pressed side, at different rates in different plants, sometimes within a few minutes, but generally after a much longer period. After temporary contact with any object, the petiole continues to bend for a considerable time; afterwards it slowly becomes straight again, and can then re-act. A petiole excited by an extremely slight weight sometimes bends a little, and then becomes habituated to the stimulus, and either bends no more or becomes straight again, the weight still remaining suspended. Petioles which have clasped any object for some little time cannot recover their original position. After remaining clasped for two or three days, they generally increase much in thickness, either throughout or on one side alone; they subsequently become, sometimes in a wonderful degree, stronger and more woody; and in some cases they acquire an internal structure like that of the stem or axis.

The young internodes of the *Lophospermum* are sensitive as well as the petioles, and by their combined movement seize any object. The flower-peduncles of the *Maurandia semperflorens* revolve spontaneously, and are sensitive to a touch, yet are certainly useless for climbing. The leaves of at least two and probably of most of the species of *Clematis*, and of *Fumaria* and *Adlumia*, spontaneously curve from side to side, like the internodes, and are thus better adapted to seize any distant object. The petioles of the perfect leaves, as well as the rudimentary or tendril-like leaves of *Tropæolum tricolorum* move spontaneously and slowly towards their own stem or the supporting stick, which they then clasp; these petioles also show some tendency to contract spirally. The tips of the uncaught leaves of the *Gloriosa*, as they grow old, contract into a flat spire. These several facts are interesting, as we shall see, in relation to true tendrils.

It was observed in some cases that, as with twining plants, so with leaf-climbers, the first internodes which rise from the ground do not spontaneously revolve; nor are the petioles or tips of the first-formed leaves sensitive. In certain species of *Clematis* the high development and spontaneous movements of the leaves, with their highly sensitive petioles, apparently have rendered almost superfluous the spontaneous movements of the internodes, which have consequently become enfeebled. In certain species of *Tropæolum* it would appear as if both the spontaneous movements of the internodes and the sensitiveness of the petioles have become enfeebled; and in one species they have been completely lost.

Part III.—Tendril-bearing Plants.

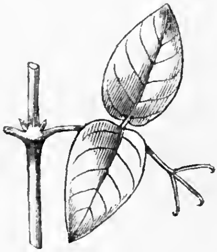
By tendrils I mean filamentary organs, sensitive to contact and used exclusively for climbing. By this definition, spines or hooks and rootlets, all of which are used for climbing, are excluded. True tendrils are formed by the modification of leaves with their petioles, of flower-peduncles, perhaps also of branches and stipules. Mohl, who includes with true tendrils various organs having a similar external appearance, classes them according to their homological nature, as being modified leaves, flower-peduncles, &c. This would be an excellent scheme; but I observe that botanists, who are capable of judging, are by no means unanimous on the nature of certain tendrils. Consequently I will describe tendril-bearing plants by natural families, following Lindley; and this will in most, or in all, cases keep those of the same homo-

logical nature together; but I shall treat of each family, one after the other, according to convenience*. The species to be described belong to ten families, and will be given in the following order:—*Bignoniaceæ*, *Polemoniaceæ*, *Leguminosæ*, *Compositæ*, *Smilaceæ*, *Fumariaceæ*, *Cucurbitaceæ*, *Vitaceæ*, *Sapindaceæ*, *Passifloraceæ*.

BIGNONIACEÆ.—This family contains many tendril-bearers, some twiners, and some root-climbers. The tendrils are always modified leaves. Nine species of *Bignonia*, selected by hazard, are here described, in order to show what diversity of structure and action there may be in species of the same genus, and to show how remarkable the action of the tendrils may be in some cases. The species, taken together, afford connecting links between twiners, leaf-climbers, tendril-bearers, and root-climbers.

Bignonia (an unnamed species from Kew, closely allied to *B. unguis*, but with smaller and rather broader leaves).—A young shoot from a cut-down plant made three revolutions against the sun, at an average rate of 2 h. 6 m. The stem is thin and flexible and twined, ascending, from left to right, round a slender vertical stick as perfectly and as regularly as any true twining-plant. When thus ascending, it makes no use of its tendrils or its petioles; but when it twined round a rather thick stick, and its petioles were brought into contact with it, these curved round the stick, showing that they have some degree of irritability. The petioles also exhibit a slight

Fig. 5†.



Bignonia, unnamed species from Kew.

* As far as I can make out, the history of our knowledge on tendrils is as follows:—We have seen that Palm and Von Mohl observed about the same time the singular phenomenon of the spontaneous revolving movement of twining-plants. Palm (S. 58), I presume, observed likewise the revolving movement of tendrils; but I do not feel sure of this, for he says very little on the subject. Dutrochet fully described this movement of the tendril in the common Pea. Mohl first discovered that tendrils were sensitive to contact; but from some cause, probably from observing too old tendrils, he was not aware how sensitive they were, and thought that prolonged pressure was necessary to excite movement. Professor Asa Gray, in a paper already quoted, first noticed the extreme sensitiveness and rapidity of movements in the tendrils of certain Cucurbitaceous plants.

† This and the following drawings, from which the woodcuts have been engraved, were carefully made for me from living plants by my son Mr. George H. Darwin.

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degree of spontaneous movement; for in one case they certainly described minute, irregular, vertical ellipses. The tendrils apparently curve themselves spontaneously to the same side with the petioles; but the movement was so slight that it may be passed over. From various causes, it was difficult to observe the movements of the petioles and tendrils in this and the two following species. The tendrils are so closely similar in all respects to those of the following species, that one description will suffice.

Bignonia unguis.—The young shoots revolve, but less regularly and less quickly than those of the last species. The stem twined imperfectly round a vertical stick, sometimes reversing its direction, exactly in the same manner as has been described in so many leaf-climbers; and this plant is in itself a leaf-climber, though possessing tendrils. Each leaf consists of a petiole bearing a pair of leaflets, and terminating in a tendril, which is exactly like that above figured, but a little larger. The whole tendril in a young plant was only about half an inch in length, and is very unlike most tendrils in shape. It curiously resembles the leg and foot of a small bird with the hind toe cut off. The straight leg or tarsus is longer than the three toes, which latter are of equal length, and, diverging, lie in the same plane; the toes terminate in sharp and hard claws, much curved downwards, exactly like the claws on a bird's foot. The whole tendril apparently represents three leaflets. The main petiole (but not the two sub-petioles of the lateral leaflets) is sensitive to contact with any object: even a small loop of thread after two days caused one to bend upwards. The whole tendrils, namely the tarsus and three toes, especially their under surfaces, are likewise sensitive to contact. Hence, when a shoot grows through branched twigs, its revolving movement soon brings the tendril into contact with some twig, and then all three toes bend (or sometimes one alone), and, after several hours, seize fast hold of the twig, exactly like a bird when perched. The tarsus, also, when it comes into contact with a twig, slowly bends, until the foot is carried quite round, and the toes pass on each side of the tarsus, or seize hold of it. If the main petiole bearing the leaflets comes into contact with a twig, it likewise bends round, until the tendril touches its own petiole or that of the opposite leaf, which is then seized. The petioles, and probably even the tendrils in a slight degree, move spontaneously; hence when a shoot attempted to twine round an upright stick, both petioles after a time came into contact with it, and the contact

caused still further bending; so that ultimately both petioles clasped the stick in opposite directions, and the foot-like tendrils, seizing on each other or on their petioles, fastened the stem to the support with surprising security. Hence this species, differently from the last, uses its tendrils, by the intervention of the spontaneously moving and sensitive petioles, when the stem twines round a thin vertical stick. Both species use their tendrils in the same manner when passing through a thicket. This plant seems to me the most efficient climber which I have examined; and it probably could ascend a polished stem incessantly tossed by heavy storms. To show how important vigorous health is for the action of all the parts, I may mention that when I first examined a plant which was growing pretty well, though not vigorously, I concluded that the tendrils acted only like the hooks on a bramble, and that this was the most feeble and inefficient of all climbers!

Bignonia Tweedyana.—This species is closely allied to, and behaves in all respects like the last; perhaps it twines round a vertical stick rather better. On the same plant, one branch twined in one direction and another in an opposite direction. The internodes in one case made two circles, each in 2 h. 33 m. I was enabled in this species to observe, better than in the two preceding, the spontaneous movements of the petioles: one described three small vertical ellipses in the course of eleven hours, another moved laterally in an irregular spire. Some little time after the stem has twined round an upright stick, and is securely fastened to it by the clasping petioles and tendrils, it emits at the base of its leaves aërial roots, which curve partly round and adhere to the stick; so that this one species of *Bignonia* combines four different methods of climbing, generally characteristic of distinct plants, namely, twining, leaf-climbing, tendril-climbing, and root-climbing.

In the foregoing three species, when the foot-like tendril has caught any object, it continues to grow and to thicken, and ultimately it becomes wonderfully strong, in the same manner as we have seen with the petioles of leaf-climbers. If the tendril catches nothing, it first slowly bends downwards, and then its power of clasping is lost. Very soon afterwards it disarticulates itself from the petiole, like a leaf in autumn from the stem, and drops off. I have seen this process of disarticulation in no other tendrils, but when uncaught they soon wither away.

Bignonia venusta.—The tendrils are here considerably modified

in comparison with those of the previous species. The lower part, or tarsus, is four times as long as the three toes; these are of equal length; they do not lie in the same plane, but diverge equally on all sides; their tips are bluntly hooked, so that the whole tendril makes an excellent grapnel. The tarsus is sensitive on all sides; but the three toes are sensitive only on their outer surfaces, which correspond with the under surfaces of the toes in the tendrils of the previous species. The sensitiveness is not much developed; for a slight rubbing with a twig did not cause the tarsus or toes to become slightly curved until an hour had elapsed; subsequently they straightened themselves. Both tarsus and toes can seize well hold of sticks. When the stem is secured, the tendrils are seen spontaneously to sweep large ellipses: the two opposite tendrils move independently of each other. I have no doubt, from the analogy of the two following allied species, that the petioles move spontaneously; but they are not irritable like those of *B. unguis* and *B. Tweedyana*. The young internodes also sweep fine large circles, one being completed in 2 h. 15 m., and a second in 2 h. 55 m. By these combined movements of the internodes, petioles, and grapnel-like tendrils, the latter are soon brought into contact with surrounding objects. When a shoot stands near an upright stick, it twines regularly and spirally round it; as it ascends, it seizes the stick with only one of its tendrils, and, if the stick be thin, the right- and left-hand tendrils are alternately used. This alternation follows from the stem necessarily taking one twist round its own axis for each completed spire.

The tendrils a short time after catching any object contract spirally. Those which have caught nothing slowly bend downwards, but do not contract spirally. With many plants the tendrils after a time contract spirally, whether or not they have caught any object. But this whole subject of the spiral contraction of tendrils will be discussed after the several tendril-bearing plants have been described.

Bignonia littoralis.—The young internodes revolve in fine large ellipses. An internode bearing immature tendrils made two revolutions, each in 3 h. 50 m.; but when grown older, with the tendrils mature, two ellipses were performed, each at the rate of 2 h. 44 m. But this species, unlike the preceding, is incapable of spirally twining round any object: this did not appear due to any want of flexibility in the internodes, or to the action of the tendrils, and certainly not to any want of the revolving power; nor can I

account for the circumstance. Nevertheless the plant readily ascends a thin upright stick by its two opposite tendrils, both seizing the stick some way above, and afterwards spirally contracting. If the tendrils seize nothing, they do not contract spirally. *Bignonia venusta* ascended a vertical stick by spirally twining and by seizing it alternately with its two tendrils like a sailor pulling himself up a rope hand over hand; our present species pulls itself straight up, like a sailor seizing with both hands together the rope above his head.

The tendrils are almost identical in structure with those of the last species. They continue growing for some time, even after clasping an object, and when fully grown, though borne by a young plant, were 9 inches in length. The three divergent toes are shorter relatively to the tarsus than in the former species; they are blunt at their tips and but slightly hooked; they are not quite equal in length, one being rather longer than the others. The outer surfaces of the three toes are highly sensitive; for when lightly rubbed with a twig, they became perceptibly curved in 4 m. and greatly curved in 7 m.; in 7 h. they became straight again and ready to react. The tarsus, for a space of one inch close to the toes, is sensitive, but in a rather less degree than the toes; for after a slight rubbing this part required about twice as long a time to bend. Even the middle part of the tarsus, if acted on soon after the tendril has arrived at maturity, is sensitive to prolonged contact. After the tendrils have grown old, the sensitiveness is confined to the toes, when they will only curl very slowly round a stick. The maturity of the tendril is shown by the divergence of the three toes, at which period their outer surfaces first become irritable. The irritability of the tendril has little power of spreading from one part to another: thus, when a stick was caught by the part immediately beneath the three toes, these often remained sticking out, and never clasped the stick.

The tendrils revolve spontaneously. The movement begins before the tendril is converted into a grapnel by the divergence of the toes, and before any part has become sensitive; so that the revolving movement is at this early period quite useless. The movement is at this time slow, two ellipses being completed conjointly in 24 h. 18 m. When the tendril was mature, an ellipse was performed in 6 h.; so that even at this period the movement is much slower than that of the internodes. Large ellipses were swept, both in vertical and horizontal planes, by the tendrils.

Not only the tendrils, but the petioles bearing them, revolve; these petioles, however, are not in the least sensitive. Thus the young internodes, the petioles, and the tendrils, all at the same time, go on revolving together, but at different rates. Moreover, the movements of the opposite petioles and tendrils are quite independent of each other. Hence, when the whole shoot is allowed freely to revolve, nothing can be more intricate than the course and rate followed by the extremity of each tendril. A wide hemisphere above the shoot is irregularly searched for some object to be grasped.

One other curious point remains to be mentioned. Some few days after the toes have closely clasped a stick, their blunt extremities become, though not invariably, developed into irregular disk-like balls, which have the singular power of adhering firmly to the wood. As similar cellular outgrowths will be fully described under *B. capreolata*, I will here say nothing more about them.

Bignonia æquinoctialis, var. *Chamberlaynii*.—The internodes, the elongated non-sensitive petioles, and the tendrils all have the power of revolving. The stem does not twine, but ascends a vertical stick in the same manner as the last species. The tendrils resemble those of the last species, but are shorter; the three toes are more unequal in length, two of them being about one-third shorter, and rather thinner than the third; but they vary in these respects. They terminate in small hard points; and what is important, they do not develope cellular adhesive disks. The reduced size of two of the toes, and their lessened sensitiveness, seem to indicate a tendency to their abortion; and the first-formed tendrils on one of my plants were sometimes quite simple. We are thus naturally led to the three following species with simple undivided tendrils.

Bignonia speciosa.—The young shoots revolve irregularly, making narrow ellipses, or spires or circles, at rates varying from 3 h. 30 m. to 4 h. 40 m.; but the plant shows no tendency to twine. Whilst very young and not requiring any support it does not produce tendrils. The tendrils of a rather young plant were five inches in length; they revolve spontaneously, as do the short and not sensitive petioles. The tendrils, when rubbed, slowly bend to the rubbed side, and subsequently straighten themselves; but they are not highly sensitive. There is something strange in their action: I repeatedly placed upright, thick and thin, rough and smooth sticks and posts, and string suspended vertically, near

them; but these objects were not well seized. The tendrils, after clasping an upright stick, repeatedly loosed it again; often they would not seize it at all, or their extremities did not coil closely round it. I have observed hundreds of tendrils in Cucurbitaceous, Passifloraceous, and Leguminous plants, and never saw one behave in this manner. When, however, my plant had grown to a height of eight or nine feet, the tendrils acted much better; and one or both regularly seized an adjoining, thin, upright stick, not high up as with the three previous species, but in a nearly horizontal plane; thus the non-twining stem was enabled to ascend the stick.

The simple undivided tendril ends in an almost straight, sharp, uncoloured point. The whole terminal part exhibits one odd habit, which in an animal would be called an instinct; for it continually searches for any little dark hole into which to insert itself. I had two young plants; and, after having observed this habit, I placed near them posts, which either had been bored by beetles, or which had become fissured in drying. The tendrils, by their own movement and by that of the internodes, slowly travelled over the surface of the wood, and when the apex came to a hole or fissure it inserted itself; for this purpose the terminal part, half or quarter of an inch in length, often bent itself at right angles to the basal part. I have watched this process between twenty and thirty times. The same tendril would frequently withdraw from one hole and insert its point into a second one. I have seen a tendril keep its point in one instance for 20 h. and in another instance for 36 h. in a minute hole, and then withdraw it.

Whilst the point of a tendril is thus temporarily inserted, the opposite tendril goes on revolving. The whole length of a tendril often fits itself closely to the surface of the wood with which it is in contact; and I have seen a tendril bend at right angles and place itself in a wide and deep fissure, with the apex again abruptly bent and inserted into a minute lateral hole. After a tendril has clasped a stick, it contracts spirally; if it catches nothing, it does not contract. When it has adapted itself to the inequalities of a thick post, though it has clasped nothing, or when it has inserted its apex into some little fissure, the stimulus suffices to induce spiral contraction; and this contraction always draws the tendril away from the post. So that in every case the above-described nicely adapted movements were absolutely useless, excepting once when the tip became jammed in a narrow

fissure. I fully expected, from the analogy of *B. capreolata* and *B. littoralis*, that the tip would have developed itself into an adhesive disk; but I could never detect even a trace of this process. Improbable as the view may be, I am led to suspect that this habit in the tendril of inserting its tip into dark holes and crevices has been inherited by the plant after having lost the power of forming adhesive disks.

Bignonia picta.—This species closely resembles the last in the structure and movements of its tendrils. I casually examined a fine growing plant of the allied *B. Lindleyi*, and this apparently behaves in all respects in the same manner.

Bignonia capreolata.—We now come to a species having tendrils of a different type: but first for the internodes. A young shoot made three large revolutions, following the sun, at an average rate of 2 h. 23 m. The stem is thin and flexible, and I have seen one make four regular spiral turns round a thin upright stick, ascending, of course, from right to left, and therefore in a reversed direction compared with the first-described species; but afterwards, from the interference of the tendrils, it ascended either straight up the stick or in an irregular spire. These tendrils are highly remarkable. In a young plant they were about 2½ inches in length, and much branched, the five chief branches apparently representing two pairs of leaflets and a terminal one; each branch is bifid or more commonly trifid toward its extremity, with all the points blunt but distinctly hooked. A tendril when lightly rubbed bends to that side, and subsequently becomes straight again; but a loop of thread weighing ¼th of a grain produced no effect. The terminal branches of a tendril twice became in 10 m. slightly curved when touching a stick; and in 30 m. the tips curled quite round the stick: the basal part is less sensitive. The tendrils revolve in an apparently capricious manner, sometimes not at all, or very slightly, but at other times they describe large regular ellipses. I could detect no spontaneous movement in the petioles.

At the same time that the tendrils are revolving more or less regularly, another remarkable movement first begins; the tendrils slowly begin to bend from the light towards the darkest side of the house. I repeatedly changed the position of my plants, and the successively formed tendrils always ended by pointing, some little time after the revolving movement had quite ceased, to the darkest side. But when I placed a thick post near a tendril, and between it and the light, the tendril pointed in that direction. In two instances a pair of leaves stood so that one tendril was directed to-

wards the light and the other to the darkest side of the house; the latter did not move, but the opposite one bent itself first upwards and then right over its fellow, so that the two became parallel, one above the other, both pointing to the dark: I then turned the plant half round; and the tendril which had turned over recovered its original position, and the opposite one, which had not moved before, now turned right over to the dark side. Lastly, on another plant, three pairs of tendrils were produced by three shoots at the same time, and all happened to be differently directed: I placed the pot in a box open only on one side, and obliquely facing the light; in two days all six tendrils pointed with unerring truth to the darkest corner of the box, though to do this each had to bend in a different manner. Six tattered flags could not have pointed more truly from the wind than did these branched tendrils from the stream of light which entered the box. I left these tendrils undisturbed for above 24 h., and then turned the pot half round; but they had now lost the power of movement, so that they could not any longer avoid the light.

When a tendril has not succeeded, either through its own revolving movement or that of the shoot, or by turning towards any object which intercepts the light, in clasping a support, it bends vertically downwards and then towards its own stem, which it seizes together with the supporting stick, if there be one. A little aid is thus given in keeping the stem secure. If the tendril seizes nothing, it does not contract spirally, but soon withers away and drops off. If it does seize an object, all its branches contract spirally.

I have stated that, after a tendril has come into contact with a stick, in about half an hour it bends round it; but I repeatedly observed, as with *B. speciosa* and its allies, that it again loosed the stick: sometimes it seized and loosed the same stick three or four times. Knowing that the tendrils avoided the light, I gave them a glass tube blackened within, and a well-blackened zinc plate: the branches curled round the tube and abruptly bent themselves round the edges of the zinc plate; but they soon recoiled, with what I can only call disgust, from these objects, and straightened themselves. I then placed close to a pair of tendrils a post with extremely rugged bark; twice the tendrils touched it for an hour or two, and twice they withdrew; at last one of the hooked extremities curled round and firmly seized an excessively minute projecting point of bark, and then the other branches spread them-

selves out, following with accuracy every inequality of the surface. I then placed a post without bark, but much fissured, and the points of the tendrils crawled into all the crevices in a beautiful manner. To my surprise, I observed that the tips of immature tendrils, with the branches not yet fully separated, likewise crawled, just like roots, into the minutest crevices. In two or three days after the tips had thus crawled into the crevices, or after their hooked ends had seized some minute point, the final process, now to be described, commenced.

This process I discovered by having accidentally left a piece of wool near a tendril. I then bound a quantity of flax, moss, and wool (the wool must not be dyed, for these tendrils are excessively sensitive to some poisons) loosely round sticks, and placed them near tendrils. The hooked points soon caught the fibres, even loosely floating fibres, and now there was no recoiling; on the contrary, the excitement from the fibres caused the hooks to penetrate the fibrous matter and to curl inwards, so that each hook firmly caught one or two fibres, or a small bundle of them. The tips and the inner surfaces of the hooks now began to swell, and in two or three days could be seen to be visibly enlarged. After a few more days the hooks were converted into whitish, irregular balls, rather above the $\frac{1}{20}$th of an inch in diameter, and formed of coarse cellular tissue, which sometimes wholly enveloped and concealed the hooks themselves. The surfaces of these balls secrete some viscid resinous matter, to which the fibres of the flax, &c. adhere. When a fibre has become fastened to the surface, the cellular tissue does not grow directly beneath it, but continues to grow closely on each side; so that when several adjoining fibres, though excessively thin, were caught, so many crests of cellular matter, each not as thick as a human hair, grew up between them, and these, arching over on both sides, grew firmly together. As the whole surface of the ball continues to grow, fresh fibres adhere and are enveloped; so that I have seen a little ball with between fifty and sixty fibres of flax crossing at various angles, all imbedded more or less deeply. Every gradation in the process could be seen—some fibres merely sticking to the surface, others lying in more or less deep furrows, or deeply imbedded, or passing through the very centre of the cellular ball. The imbedded fibres are so closely clasped that they cannot be withdrawn. The cellular outgrowth has such a tendency to unite, that two balls produced from two branches sometimes grow into a single one.

On one occasion, when a tendril had curled round a small stick, half an inch in diameter, an adhesive disk was formed; but generally the tendrils can do nothing with smooth sticks or posts. If, however, the tip of any one branch can curl round the minutest projecting point, the other branches will form disks, especially if they can find crevices to crawl into. The tendril quite fails to attach itself to a brick wall.

I infer that the disks or balls secrete some resinous adhesive matter, from the adherence of the fibres to them, but more especially from such fibres becoming loose after immersion in sulphuric ether, which likewise removes small, brown, glistening points that can generally be seen on the surface of the older disks. If the hooked extremities of the tendrils touch nothing, the cellular outgrowth, as far as I have seen, never commences; but temporary contact during a moderate time causes small disks to be formed. I have seen eight disks developed on one tendril. After the development of the disks, the tendrils, which now become spirally contracted, likewise become woody and very strong. A tendril in this state supported nearly seven ounces, and would apparently have supported a considerably greater weight had not the fibres of flax to which the disks were attached yielded.

From the facts above given, I infer that though the tendrils of this *Bignonia* can occasionally adhere to smooth cylindrical sticks and often to rugged bark, yet that they are specially adapted to climb trees clothed with lichens, mosses, or with *Polypodium incanum*, which I hear from Professor Asa Gray is the case with the forest-trees where this *Bignonia* grows. Finally, it is a highly remarkable fact that a leaf should become metamorphosed into a branched organ which turns from the light, and which can by its extremities either crawl like roots into crevices, or seize hold of minute projecting points, these extremities subsequently forming cellular masses which envelope by their growth the finest fibres and secrete an adhesive cement.

Eccremocarpus scaber (*Bignoniaceæ*).—Plants in the greenhouse, though growing pretty well, showed no spontaneous movements in their shoots or tendrils; but, removed to the hot-house, the young internodes revolved at rates varying from 3 h. 15 m. to 1 h. 13 m.: at this latter unusually quick rate one large circle was swept; but generally the circles or ellipses were small, and sometimes the course pursued was extremely irregular. An internode which had made several revolutions would sometimes stand

quite still for 12 h. or 18 h., and then recommence revolving; such strongly marked interruptions in the movements I have observed in no other plant.

The leaves bear four leaflets, themselves subdivided, and terminate in a much-branched tendril. The main petiole of the leaf, whilst young, moves spontaneously by curving itself, and follows nearly the same irregular course, and at about the same rate, with the internodes. The movement to and from the stem is naturally the most conspicuous, and I have seen the chord of the curved petiole forming an angle of 59° with the stem, and an hour afterwards an angle of 106°. The two opposite petioles do not move together, and one is sometimes raised so much as to stand close to the stem whilst the other is not far from horizontal. The basal part of the petiole moves less than the distal part. The tendrils, besides being carried by the moving petioles and internodes, themselves move spontaneously, and the opposite tendrils occasionally move in opposite directions. By these several movements of the young internodes, of the petioles, and of the tendrils, all acting together, a wider space is swept for a support.

In young plants, the tendrils are about three inches in length: they bear two lateral and two terminal branches; and each branch bifurcates twice, with the tips forming blunt double hooks, having both points directed to the same side. All the branches are sensitive on all sides; and after being lightly rubbed, or after coming into contact with a stick, they bend in about 10 m. One that became, after a light rub, curved in 10 m., continued bending for between 3 h. and 4 h., but subsequently in 8 h. or 9 h. became straight again. Tendrils, which have caught nothing, ultimately contract into an irregular spire, as they do also, only much more quickly, after clasping a support. In both cases the petiole bearing the leaflets, which at first is straight and inclined a little upwards, moves downwards and abruptly bends itself in the middle into a right angle; but this is more plainly seen in *E. miniatus* than in *E. scaber*. The action of the tendrils in the *Eccremocarpus* is in some respects analogous to that of the tendrils of *Bignonia capreolata*; but the whole tendril does not move from the light, nor do the hooked tips become enlarged into cellular disks. After the tendrils have come into contact with moderately thick cylindrical sticks or with rugged bark, the several branches may be observed slowly to lift themselves up, change their position, and again come into contact with them. The object of these

movements is that the double hooks at the extremities of the branches, which naturally face in all directions, may be brought into contact with the wood. I have watched a tendril, which had bent itself at right angles abruptly round the sharp corner of a post, neatly bring every single hook into contact with both surfaces. The appearance suggested the belief, that though the whole tendril is not sensitive to light, yet that the tips are so, and that they turn and twist themselves towards any opaque surface. Ultimately the branches arrange and fit themselves very neatly to all the irregularities of the most rugged bark, so that they resemble in their irregular course a river with its branches, as engraved on a map. But when a tendril has thus arranged itself round a rather thick smooth stick, the subsequent spiral contraction generally spoils the neat arrangement, and draws the tendril from its support. So it is, but not in quite so marked a manner, when a tendril has spread itself over the rugged bark of a thick trunk; for in this case the spiral contraction of the opposite branches sometimes draws the opposed hooks firmly to their supports. Hence we may conclude that these tendrils are not perfectly adapted to seize smooth moderately thick sticks or rugged bark. When a thin stick or twig is placed near a tendril, its terminal branches wind quite round it and seize their own lower branches or main stem; and the stick is thus firmly, but not neatly, grasped. The extremities of the branches, close to the little double hooks, have a strong tendency to curl inwards, and are excited to this movement by contact with the thinnest objects. This accounts for the tendrils apparently preferring such objects as excessively thin culms of a grass, or the long flexible bristles of a brush, or the thin rigid leaves of an Asparagus, all which objects they seized in an admirable manner; for the tips of each sub-branch seized one, two, or three of the bristles, for instance, and then the spiral contraction of the several branches brought all these little parcels close together, so that thirty or forty bristles were drawn into a single bundle, and afforded an excellent support.

POLEMONIACEÆ.—*Cobæa scandens.*—This is an admirably constructed climber. The terminal portion of the petiole, which forms the tendril, was in one very fine specimen eleven inches in length, with the basal part bearing two pairs of leaflets, only two and a half inches in length. The tendril of the *Cobæa* revolves more rapidly and vigorously than in any other plant observed by me, with the exception of one *Passiflora*. It made three fine large, nearly

circular sweeps, against the sun, each in 1 h. 15 m., and two others in 1 h. 20 m. and 1 h. 23 m. Sometimes it travels in a much inclined position, and sometimes nearly upright. The lower part moves but little, and the basal portion or petiole, which bears the leaflets, not at all; nor do the internodes revolve; so that here we have the tendril alone moving. With most of the species of *Bignonia* and with *Eccremocarpus*, the internodes, tendrils, and petioles all revolve. The long, straight, tapering main stem of the tendril of the *Cobæa* bears alternate branches; and each branch is several times divided, with the finer branches as thin as very thin bristles, extremely flexible, so that they are blown about by a breath of air, yet strong and highly elastic. The extremity of each branch is a little flattened, and terminates in a minute double (but sometimes single) hook, formed of hard, transparent, woody substance, and as sharp as the finest needle. On the eleven-inch tendril I counted ninety-four of these beautifully constructed little hooks. They readily catch soft wood, or gloves, or the skin of the hands. Excepting these hardened hooks, and excepting the basal part of the central stem of the tendril, every part of every branch is highly sensitive on all sides to a slight touch, and bends in a few minutes towards the touched side. By lightly rubbing several branches on different and opposite sides, the whole tendril rapidly assumes an extraordinarily crooked shape: these movements from contact do not interfere with the ordinary revolving movement. The branches, after becoming greatly curved from being touched, straighten themselves at a quicker rate than in almost any other tendril seen by me, namely, in between half an hour and an hour. After the tendril has caught any object, the spiral contraction also begins after an unusually short interval of time, namely, in about twelve hours.

Before the tendril is mature, the terminal branches cohere and the hooks are curled closely inwards: at this period no part is sensitive to a touch; but as soon as all the branches have diverged and the hooks stand out, full sensitiveness is acquired. It is a singular circumstance that the immature tendril, before becoming sensitive, begins to revolve at its full velocity: this movement must be useless, as the tendril in this state can catch nothing: it is a rare instance of a want, though only for a short time, of perfect coadaptation in the structure and functions of a climbing-plant. The petiole with the tendril perfectly matured, but with the leaflets still quite small, stands at this period vertically upwards, the young growing shoot or axis being thrown to one side. The ten-

dril thus standing vertically up sweeps a circle right above the stem, and is well adapted to catch some object above, and to favour the ascent of the plant. The whole leaf, with its tendril, after a short time, bends downwards to one side, allowing the next succeeding leaf to become vertical, and ultimately it assumes a horizontal position; but, before this has occurred, the tendril, supposing it to have caught nothing, has lost its powers of movement and has spirally contracted into an entangled mass. In accordance with the rapidity of all the movements, their duration is short: in a plant growing vigorously from being placed in a hot-house, a tendril only revolved for about 36 hours, counting from the period when it became sensitive; but during this period it probably made at least 27 revolutions.

When the branches of a revolving tendril strike against a stick, they quickly bend round and clasp it; but the little hooks play an important part, especially if only the extremity of the tendril be caught, in preventing its being dragged by the rapid revolving movement away too quickly for its irritability to act. As soon as a tendril has bent round a smooth stick or a thick rugged post, or has come into contact with planed wood (for it can at least temporarily adhere even to so smooth a surface as this), the same peculiar movements begin in the branchlets as have been described in those of the *Bignonia capreolata* and the *Eccremocarpus*, namely, the branchlets lift themselves up and down; those, however, which have their hooks already directed downwards remain in this position and secure the tendril, whilst the others twist about till they arrange themselves in conformity with every irregularity of the surface, and bring their hooks, originally facing in various directions, into contact with the wood. The use of the hooks was shown by giving the tendrils tubes and slips of glass to catch; for these, though temporarily seized, were afterwards invariably lost, either during the arrangement of the branches or when the spiral contraction ensued.

The perfect manner in which the branches arrange themselves, creeping like rootlets over all the inequalities and into any deep crevice, is quite a pretty sight; for it is perhaps more effectually done than by the tendrils of the former species, and is certainly more conspicuous, as the upper surfaces of the main stem and of every branch to the extreme hooks are angular and coloured green, whilst the lower surfaces are rounded and purple. I was led to infer, as in the former cases, that light guided these conforming movements of the branches of the tendrils. I made

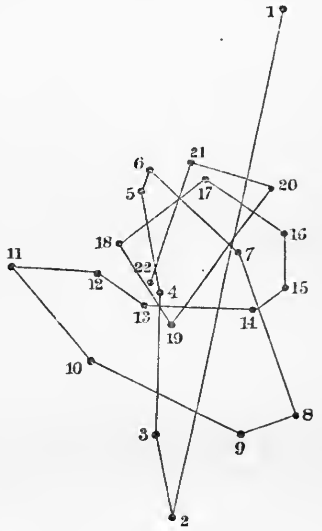
many trials with black and white glass and cards to prove it, but failed from various causes; yet these trials countenanced the belief. The tendril may be looked at as a leaf split into filaments, with the segments facing in all directions; hence, when the revolving movement is arrested, so that the light shines on them steadily in one direction, there is nothing surprising in their upper surfaces turning towards the light: now this may aid, but will not account for, the whole movement; for the segments would in this case move towards the light as well as turn round to it, whereas in truth the segments or branches of the tendrils not only turn their upper surfaces to the light, and their lower surfaces which bear the hooks to any closely adjoining opaque object (that is, to the dark), but they actually curve or bend from the light towards the dark.

When the *Cobæa* grows in the open air, the wind must aid the extremely flexible tendrils in seizing a support, for I found a mere breath sufficed to cause the extreme branches of a tendril to catch by their hooks twigs which they could not have reached by the revolving movement. It might have been thought that a tendril thus hooked only by its extremity could not have fairly grasped its support. But several times I watched cases like the following, one of which alone I will describe: a tendril caught a thin stick by the hooks of one of its two extreme branches; though thus held by the tip, it continued to try to revolve, bowing itself out to all sides, and thus moving its branches; the other extreme branch soon caught the stick; the first branch then loosed itself, and then, arranging itself afresh, again caught hold. After a time, from the continued movement of the tendril, a third branch became caught by a single extreme hook; no other branches, as things then remained, could possibly have touched the stick; but before long the main stem, towards its extremity, began just perceptibly to contract into an open spire, and thus to shorten itself (dragging the whole shoot towards the stick), and as it continued to try to revolve, a fourth branch was brought into contact. As the spiral contraction travelled down the main stem and down the branches of the tendril, all the lower branches, one after another, were brought into contact with the stick, and were wound round it and round their own branches until the whole was tied together in an inextricable knot round the stick. The branches of a tendril, though at first so flexible, after having clasped a support for a time, become rigid and even stronger than they were at first. Thus the plant is secured to its support in a perfect manner.

LEGUMINOSÆ.—*Pisum sativum.*—The common Pea was the subject of a valuable memoir by Dutrochet*, who discovered that both the internodes and tendrils revolved in ellipses. The ellipses are generally very narrow, but sometimes approach to circles: I several times observed that the longer axis slowly changed its direction, which is of importance, as the tendril thus sweeps a much wider circuit. Owing to this change of direction, and likewise to the movement of the stem towards the light, the successive irregular ellipses generally form an irregular spire. I have thought it worth while to annex a tracing of the course pursued by the upper internode (the movement of the tendril being neglected) of a young plant from 8.40 A.M. to 9.15 P.M. The course was traced on a hemispherical glass placed over the plant, and the dots with figures give the hours of observation; each dot was joined by a straight line: no doubt these lines, if the course had been observed at shorter intervals, would have been all curvilinear. The extremity of the petiole, where the young tendril arises, was 2 inches from the glass, so that if a pencil 2 inches long had been in imagination affixed to the petiole, it would have traced the annexed figure on the under side of the glass; but it must be remembered that the figure is here reduced one-half. Neglecting the first great sweep towards the light or window, the end of the petiole swept a space 4 inches across in one direction, and 3 inches in another. As a full-grown tendril is considerably above 2 inches in length, and as the

Fig. 3.

Diagram showing the movement of the upper internodes of the common Pea, traced on a hemispherical glass and transferred to paper; reduced one-half in size. (Aug. 1st.)



Side of room with window.

	h. m.		h. m.		h. m.
1.	8 46 A.M.	9.	1 55 P.M.	16.	5 25 P.M.
2.	10 0 „	10.	2 25 „	17.	5 50 „
3.	11 0 „	11.	3 0 „	18.	6 25 „
4.	11 37 „	12.	3 30 „	19.	7 0 „
5.	12 7 P.M.	13.	3 48 „	20.	7 45 „
6.	12 30 „	14.	4 40 „	21.	8 30 „
7.	1 0 „	15.	5 5 „	22.	9 15 „
8.	1 30 „				

* Comptes Rendus, tom. xvii. 1843, p. 989.

tendril itself bends and revolves in harmony with the internode, a considerably wider space than that here specified (and represented one-half reduced) is swept. Dutrochet observed an ellipse completed in 1h. 20m.; I saw one completed in 1h. 30m. The direction followed is variable, either with or against the sun.

Dutrochet asserts that the petiole of the leaf spontaneously moves, as well as the young internodes and tendrils; but he does not say that he secured the internodes; when this was done, I never detected any movement in the petiole, except to and from the light.

The tendrils, on the other hand, when the internodes and petioles were secured, described irregular spires or regular ellipses, exactly like those made by the internodes. A young tendril, only $1\frac{1}{8}$ inch in length, revolved. Dutrochet has shown that when a plant is placed in a room, so that the light enters laterally, the internodes travel much quicker to the light than from it: on the other hand, he asserts that the tendril itself moves from the light towards the dark side of the room. With due deference to this great observer, I think he was mistaken, owing to his not having secured the internodes. I took a young plant with highly sensitive tendrils, and tied the petiole so that the tendril alone could move; it completed a perfect ellipse in 1h. 30m.; and I then turned the plant half round, so that the opposite side faced the light, but this made no change in the direction of the succeeding ellipse. The next day I watched a plant similarly secured until the tendril (which was highly sensitive) made an ellipse in a line exactly to and from the light; the movement was so great that the tendril bent itself down at the two ends of its elliptical course into a line a little beneath the horizon, thus travelling more than 180 degrees; but the curvature was fully as great towards the light as towards the dark side of the room. I believe Dutrochet was misled by not having secured the internodes, and by having observed a plant of which the internodes and tendrils, from inequality of age, no longer curved or moved in harmony together.

Dutrochet made no observations on the sensitiveness of the tendrils; these, whilst young and about an inch in length, with the leaflets on the petiole only partially expanded, are highly sensitive; a single light touch with a twig on the inferior or concave surface near the tip caused them quickly to bend, as did occasionally a loop of thread weighing one-seventh of a grain. The upper or convex surface is barely or not at all sensitive. After bending from a touch the tendril straightened itself in

about two hours, and was ready to act again. As soon as the tendrils begin to grow old their extremities become hooked, and they then appear, with their two or three pairs of branches, an admirable grappling instrument; but this is not really the case, for at this period the tips have generally quite lost their sensitiveness; when hooked on to twigs some were not at all affected, and others required from 18h. to 24h. to clasp the twigs. Ultimately the lateral branches of the tendril, but not the middle or main stem, contract spirally.

Lathyrus aphaca.—As the tendril here replaces the whole leaf (except occasionally in very young plants), the leaf itself being replaced in function by the large stipules, it might have been expected that the tendrils would have been highly organized; this, however, is not so. They are moderately long, thin, and unbranched, with their tips slightly curved: they are sensitive whilst young on all sides, but chiefly on the concave side of the extremity. They have no spontaneous revolving power, but are at first inclined upwards at an angle of about 45°, then move into a horizontal position, and ultimately bend downwards. The young internodes, on the other hand, revolve in ellipses, and carry with them the tendrils: two ellipses were completed, each in nearly 5h.; the longer axes of these two, and of some subsequently formed ellipses, were directed at about an angle of 45° from the line of the axis of the previous ellipse.

Lathyrus grandiflorus.—The plants observed were young, and not growing vigorously, yet sufficiently so, I think, for my observations to be trusted. Here we have the rare case of neither internodes nor tendrils having any spontaneous revolving power. The tendrils in vigorous plants are above 4 inches in length, and are often twice divided into three branches; the tips are curved and are sensitive on the concave side; the lower part of the central stem is hardly at all sensitive. Hence this plant climbs simply by its tendrils being brought, through the growth of the stem, or the more efficient aid of the wind, into contact with surrounding objects, which are then effectually clasped. I may add that the tendrils, or the internodes, or both, of *Vicia sativa* spontaneously revolve.

Compositæ.—*Mutisia clematis.*—The enormous family of Compositæ is well known to include very few climbing plants. We have seen in the Table in the first Part that *Mikania* is a regular twiner, and *Mutisia* is the only genus, as far as I can learn, which bears tendrils: it is therefore interesting to discover that these tendrils, though rather less metamorphosed from their primordial

foliar nature than most other tendrils, yet display all the ordinary characteristic movements, both those that are spontaneous and those excited by contact.

The long leaf bears seven or eight alternate leaflets, and terminates in a tendril which, in a plant of considerable size, was 5 inches in length. It consists generally of three branches, which evidently represent in a much elongated condition the petioles and midribs of three leaflets; for the branches of the tendril are exactly like the petioles and midribs of the leaflets, being square on the upper surface, furrowed, and edged with green. Moreover, in the plant whilst quite young, the green edging to the branches of the tendrils sometimes expands into narrow laminæ or blades. Each branch is curved a little downwards, and is slightly hooked at its extremity.

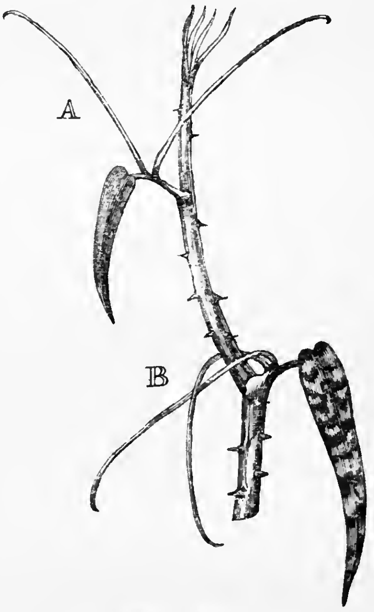
An upper young internode revolved, judging from three revolutions, at an average rate of 1h. 38m.; it swept ellipses with the longer axes directed at right angles to each other; the plant, apparently, cannot twine. The petiole which bears the tendril, and the tendril itself, are both in constant movement. But the movement is slower and much less regularly elliptical than that of the internodes; it is, apparently, much affected by the light, for the whole leaf usually sank during the night and rose during the day, moving in a crooked course to the west. The tips of the tendrils are highly sensitive on their lower surfaces: one just touched with a twig became perceptibly curved in 3 m., and another became so in 5 m.; the upper surface is not at all sensitive; the sides are moderately sensitive, so that two branches rubbed on their adjoining sides converged and crossed each other. The petiole of the leaf and the lower part of the tendril, halfway between the upper leaflet and the lowest tendril-branch, are not sensitive. A tendril after curling from a touch became straight again in about 6h., and was ready to react; but one that had been so roughly rubbed as to have coiled into a helix was not perfectly straight after 13h. The tendrils retain their sensibility to an unusual age; for one borne by a leaf, with five or six fully developed leaves above it, was still active. If a tendril catches nothing, the tips of its branches, after a considerable interval of time, spontaneously curl a little inwards; but if the tendril has clasped some object, the whole length contracts spirally.

Smilaceæ.—*Smilax aspera*, var. *maculata*.—Aug. St.-Hilaire* considers the tendrils which rise in pairs from the petiole as

* Leçons de Botanique, &c., 1841, p. 170.

modified lateral leaflets; but Mohl (S. 41) ranks them as modified stipules. These tendrils are from $1\frac{1}{2}$ to $1\frac{3}{4}$ inch in length, are thin, and have slightly curved, pointed extremities. They diverge a little from each other, but stand at first nearly upright. When lightly rubbed on either side, they slowly bend to that side, and subsequently become straight again. The back or convex side of a tendril placed in contact with a stick became just perceptibly curved in 1 h. 20 m., but did not completely surround the stick till 48 h. had elapsed; the concave side of another tendril became considerably curved in 2 h., and fairly clasped the stick in 5 h. As the tendrils grow old, they diverge more from each other and slowly bend towards the stem and downwards, so that they project on the opposite side of the stem to that on which they arise; they still retain their sensitiveness, and can clasp a support placed behind the stem. Owing to this movement, the plant can ascend a thin upright stick, clasping it with the tendrils which arise from the leaves placed alternately on opposite sides of the stem. Ultimately the two tendrils belonging to the same petiole, if they do not come into contact with any object, cross each other (as at B in fig. 7) behind the stem and loosely clasp it. This movement of the tendrils towards and round the stem is, to a certain extent, guided by the action of the light; for when the plant stood so that one of the two tendrils in thus slowly moving had to travel towards the light, and the other from the light, the latter always travelled, as I repeatedly observed, more quickly than its fellow. The tendrils do not contract spirally in any case. Their chance of finding a support depends on the growth of the plant, on the wind, and on their own slow backward and downward movement, which is guided, to

Fig. 7.



Smilax aspera.

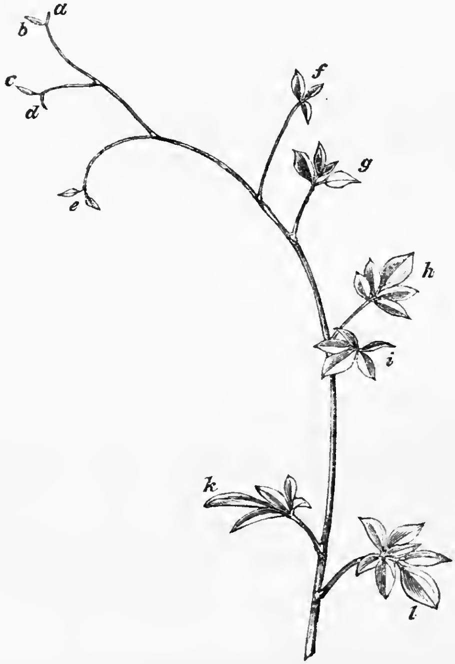
a certain extent, by the movement from the light or towards any dark object; for neither the internodes nor the tendrils have any proper revolving movement. From this latter circumstance, from the slow movements of the tendrils after contact (though their sensitiveness is retained for an unusual length of time), from their simple structure and shortness, this plant shows less perfection in its means of climbing than any other tendril-bearing plant observed by me. Whilst young and only a few inches in height, it does not produce any tendrils; and considering that it grows to only about 8 feet high, that the stem is zigzag, and is furnished, as well as the petioles, with spines, it is surprising that it should be provided with tendrils, comparatively inefficient though they be. The plant might have been left, one would have thought, to climb by the aid of its spines alone, like our brambles. But, then, it belongs to a genus some of the species of which are furnished with much longer tendrils; and we may believe that *S. aspera* is endowed with these organs solely from being descended from progenitors more highly organized in this respect.

FUMARIACEÆ. — *Corydalis claviculata.* — According to Mohl (S. 43), both the leaves and the extremities of the branches are converted into tendrils. In the specimens examined by me all the tendrils were certainly foliar, and it is hardly credible that the same plant should produce tendrils of such widely different homological natures. Nevertheless, from this statement by Mohl, I have ranked this *Corydalis* amongst tendril-bearers; if classed exclusively by its foliar tendrils, it would be doubtful whether it ought not to have been placed amongst leaf-climbers, with its allies, *Fumaria* and *Adlumia.* A large majority of its so-called tendrils still bear leaflets, though excessively reduced in size; some few of them may be properly designated as tendrils, for they are completely destitute of laminæ or blades. Consequently we here behold a plant in an actual state of transition from a leaf-climber to a tendril-bearer. Whilst the plant is young, only the outer leaves, but when full-grown all the leaves, have their extremities more or less perfectly converted into tendrils. I have examined specimens from one locality alone, viz. Hampshire; and it is not improbable that plants growing under different conditions might have their leaves a little more or less changed into true tendrils.

Whilst the plant is quite young, the first-formed leaves are not modified in any way, but those next formed have their terminal leaflets reduced in size, and soon all the leaves assume the struc-

ture represented in the following diagram. This leaf bore nine leaflets; the lower ones are much subdivided. The terminal portion of the petiole, about $1\frac{1}{2}$ inch in length (above the leaflet (*f*)), is thinner and more elongated than the lower part, and may

Fig. 8.



Corydalis claviculata.
Leaf-tendril, of natural size.

be considered as the tendril. The leaflets borne by this part are greatly reduced in size, being, on an average, about the tenth of an inch in length and very narrow; one small leaflet measured one-twelfth of an inch in length and one-seventy-fifth in breadth, so that it was almost microscopically minute. All the reduced leaflets have branching nerves, and terminate in little spines like the fully developed leaflets. Every gradation can be traced, until we come to branchlets (as *a* and *d* in the figure) which show no vestige of a lamina or blade. Occasionally all the terminal branchlets of the petiole are in this latter condition, and we then have a true tendril.

The several terminal branches of the petiole bearing the much-

reduced leaflets (*a, b, c, d*) are highly sensitive, for a loop of thread weighing only the one-sixteenth of a grain caused them, in under 4h., to become greatly curved: when the loop was removed, the petioles straightened themselves in about the same time. The petiole (*e*) was rather less sensitive; and in another specimen, in which the corresponding petiole bore rather larger leaflets, a loop of thread weighing one-eighth of a grain did not cause curvature until 18h. had elapsed. Loops of thread weighing one-fourth of a grain, left suspended on all the lower petioles (*f* to *l*) during several days, produced no effect. Yet the three petioles *f*, *g*, and *h* are not quite insensible, for when left in contact with a stick for a day or two they slowly curled round it. So that the sensibility of the petiole gradually diminishes from the tendril-like extremities to the base. The internodes are not at all sensitive, which makes Mohl's statement that they are sometimes converted into tendrils the more surprising, not to say improbable.

The whole leaf, whilst young and sensitive, stands almost vertically upwards, as we have seen is the case with many tendrils. It is in continual movement, and one that I observed swept large, though irregular, ellipses, sometimes narrow, sometimes broad, with their longer axes directed to different points of the compass, at an average rate of about 2h. for each revolution. The young internodes also, which bear the revolving leaves, likewise revolve irregularly in ellipses and spires; so that by these combined movements a considerable space is swept for a support. If the terminal and attenuated portion of the petiole fails in seizing any object, it ultimately bends downwards and inwards, and then soon loses all its irritability and power of movement. This bending down is of a very different nature from that which occurs with the extremities of the young leaves in many species of *Clematis*; for these, when thus bent or hooked, first acquire their full degree of sensitiveness.

Dicentra thalictrifolia.—In this allied plant the metamorphosis of the terminal leaflets has been complete, and they are converted into perfect tendrils. Whilst the plant was young, the tendrils appeared like modified branches, so that a distinguished botanist thought this was their nature; but in a full-grown plant, there can be no doubt, as I am assured by Dr. Hooker, that the tendrils are modified leaves. The tendrils, when of full size, are above 5 inches in length; they bifurcate twice, thrice, or even four times; their extremities are hooked, but blunt. All the branches of the tendrils are sensitive on all sides, but the basal

portion of the main stem is only slightly sensitive. The terminal branches lightly rubbed with a twig did not curve until from 30m. to 42m. had elapsed: they slowly became straight again in between 10h. and 20h. A loop of thread weighing one-eighth of a grain plainly caused the thinner branches to curve, as did occasionally a loop weighing one-sixteenth of a grain; but this latter slight weight, though left suspended, was not sufficient to cause a permanent flexure. The whole leaf with its tendril and the young upper internode together revolve vigorously and quickly, though irregularly, and sweep a wide space. The figure traced on a bell-glass was either an irregular spire or a zigzag line. The nearest approach to an ellipse was an elongated figure of 8, with one end a little open; this was completed in 1h. 53m. During a period of 6h. 17m. another shoot made a complex figure, apparently representing three and a half ellipses. When the lower part of the petiole bearing the leaflets was securely fastened, the tendril itself described similar but much smaller figures.

This species climbs well. The tendrils after clasping a stick become thicker and more rigid; but the blunt hooks do not turn and adapt themselves to the supporting surface, as is the case in so perfect a manner with some of the Bignoniaceæ and the *Cobæa.* In young plants 2 or 3 feet in height, the tendrils, which are only half the length of those borne by the same plants when grown taller, do not contract spirally after clasping a support, but only become slightly flexuous. Full-sized tendrils, on the other hand, contract spirally, excepting the thick basal portion. Tendrils which have caught nothing simply bend downwards and inwards, like the extremities of the leaves of the *Corydalis claviculata.* But in all cases the petiole after a time becomes angularly and abruptly bent like that of the *Eccremocarpus.*

Cucurbitaceæ.—The tendrils in this family have been ranked by several competent judges as modified leaves, stipules, and branches; or the same tendril as part leaf and part branch. De Candolle considers the tendrils in two of the tribes as different in their homological nature*. From facts recently adduced, Mr. Berkeley thinks that Payer's view is the most probable, namely, that the tendril is "a separate portion of the leaf itself"†.

* I am indebted to Prof. Oliver for information on this head. In the Bulletin de la Société Botanique de France, 1857, there are numerous discussions on the nature of the tendrils in this family.

† Gardeners' Chronicle, 1864, p. 721. From the affinity of the Cucurbitaceæ to the Passifloraceæ, it might be argued that the tendrils of the former are

Echinocystis lobata.—I made numerous observations on this plant (raised from seed sent me by Prof. Asa Gray), for here I first observed the spontaneous revolving movement of the internodes and of the tendrils; and knowing nothing of the nature of these movements, was infinitely perplexed by the whole case, and by the false appearance of twisting of the axis. My observations may now be greatly condensed. I recorded thirty-five revolutions of the internodes and tendrils; the slowest rate was 2 h., and the average, with no great fluctuations, was 1 h. 40 m. for each revolution. Sometimes I tied the internodes, so that the tendrils alone moved; at other times I cut off the tendrils whilst very young, so that the internodes revolved by themselves; but the rate was not thus affected. The course generally pursued was with the sun, but often in the opposite direction; sometimes the movement during a short time would either stop or be reversed; and this apparently resulted from the interference of the light, shortly after the plant was placed close to a window. In one instance, an old tendril, which had nearly ceased revolving, moved in one direction, whilst the young tendril above moved in the opposite direction. The two uppermost internodes alone revolve; as the internodes grow old, the upper part alone moves. The summit of the upper internode made an ellipse or circle about 3 inches in diameter, whilst the tip of the tendril swept a circle 15 or 16 inches in diameter. During the revolving movement the internodes become successively curved to all points of the compass; and often in one part of their course they were inclined, together with the tendril, at about 45° to the horizon, and in another part stood vertical. There was something in the appearance of the revolving internodes which continually gave the false impression that their movement was due to the weight of the long and spontaneously revolving tendril; but, on suddenly cutting off the tendril with a sharp scissors, the top of the shoot rose very little, and went on revolving: this false appearance is apparently due to the internodes and tendrils all curving and moving harmoniously together.

I repeatedly saw that the revolving tendril, though inclined during the greater part of its course at an angle of about 45° (in one case of only 37°) above the horizon, in one part of its course stiffened and straightened itself from tip to base, and became

modified flower-peduncles, as is certainly the case with the tendrils of Passion-flowers. Mr. R. Holland (Hardwicke's 'Science-Gossip,' 1865, p. 105) states that "a cucumber grew, a few years ago, in my own garden, where one of the short prickles upon the fruit had grown out into a long curled tendril."

nearly or quite vertical. This occurred both when the supporting internodes were free and when they were tied up; but was perhaps most conspicuous in the latter case, or when the whole shoot happened to stand in an inclined position. The tendril forms a very acute angle with the extremity of the shoot, which projects above the point where the tendril arises; and the stiffening always occurred as the tendril approached, and had to pass in its revolving course, the point of difficulty—that is, the projecting extremity of the shoot. Unless the tendril had the power of thus acting, it would strike against the extremity of the shoot, and be arrested by it. As soon as all three branches of the tendril have begun to stiffen themselves in this remarkable manner, as if by a process of turgescence, and to rise from an inclined into a vertical position, the revolving movement becomes more rapid; and as soon as the tendril has succeeded in passing the extremity of the shoot, its revolving motion, coinciding with that from gravity, often causes it to fall into its previously inclined position so quickly, that the end of the tendril could be distinctly seen travelling like the minute hand of a gigantic clock.

The tendrils are thin, from 7 to 9 inches in length, with a pair of short lateral branches rising not far from the base. The tip is slightly but permanently curved, so as to act to a limited extent as a hook. The concave side of the tip is highly sensitive to a touch, but not so the convex side, as was likewise observed by Mohl (S. 65) with other species of the family. I repeatedly proved this difference by lightly rubbing four or five times the convex side of one tendril, and only once or twice the concave side of another tendril, and the latter alone curled inwards: in a few hours afterwards, when those which had been rubbed on the concave side had recovered themselves, I reversed the process of rubbing, and always with a similar result. After touching the concave side, the tip becomes sensibly curved in one or two minutes; and subsequently, if the touch has been at all rough, it becomes coiled into a helix. But this helix will, after a time, uncoil itself, and be ready to act again. A loop of thin thread only one-sixteenth of a grain in weight caused a temporary flexure in a tendril. One of my plants had two shoots near each other, and the tendrils were repeatedly drawn across each other, but it is a singular fact that they did not once catch each other. It would appear as if the tendrils had become habituated to the contact of other tendrils, for the pressure thus caused would apparently be greater than that caused by a loop of soft thread weighing only the one-sixteenth

of a grain. So it would appear that the tendrils are habituated to drops of water or to rain; for artificial rain made by violently flirting a wet brush produced not the least effect on them. I repeatedly rubbed rather roughly the lower part of a tendril, but never caused any curvature; yet this part is sensitive to prolonged pressure, for when it came into contact with a stick, it would slowly bend round it.

The revolving movement is not stopped by the extremity curling after having been touched. When one of the lateral branches of a tendril has firmly clasped any object, the middle branch continues to revolve. When a stem is bent down and secured, so that its tendril depends but is left free to move, its previous revolving movement is nearly or quite stopped; but it begins to rise in a vertical plane, and as soon as it has become horizontal the revolving movement recommences. I tried this four times; generally the tendril rose to a horizontal position in an hour or an hour and a half; but in one case, in which the tendril depended at an angle of 45° beneath the horizon, the movement took two hours; in another half-hour the tendril rose to 23° above the horizon and recommenced revolving. This upward vertical movement is independent of the action of light, for it took place twice in the dark, and another time with the light coming in on one side alone. The movement no doubt is guided by opposition to the force of gravity, as in the case of the ascent of the plumules of germinating seeds.

A tendril does not long retain its revolving power; as soon as this ceases, it bends downwards and contracts spirally. But after the revolving movement has ceased the tip still retains for a short time its sensitiveness to contact, but this can be of little service to the plant.

Though the tendril is highly flexible, and though the extremity travels, under favourable circumstances, at about the rate of an inch in two minutes and a quarter, yet its sensitiveness to contact is so great that it hardly ever fails to seize a thin stick placed in its path. The following case surprised me much: I placed a thin, smooth, cylindrical stick (and I repeated the experiment seven times) so far from a tendril, that its extremity could only curl half or three-quarters round the stick; but I always found in the course of a few hours afterwards that the tip had managed to curl twice or even thrice quite round the stick. I at first thought that this was due to rapid growth; but by coloured points and measurements I proved that there was no sensible increase of

length by growth. When a stick, flat on one side, was similarly placed, the tip of the tendril could not curl beyond the flat surface, but coiled itself into a helix, which, turning to one side, lay flat on the little flat surface of wood. In one instance a portion of tendril three-quarters of an inch in length was thus dragged on to the flat surface by the coiling in of the helix. But the tendril thus acquires a very insecure hold, and generally slips off: in one case alone the helix subsequently uncoiled itself, and the tip then passed round and clasped the stick. The formation of a helix on the flat side of a stick apparently shows us that the continued striving of the tip to curl itself closely inwards gives the force which drags the tendril round a smooth cylindrical stick. In this latter case, whilst the tendril was slowly and quite insensibly crawling onwards, I several times observed through a lens that the whole surface was not in close contact with the stick; and I can understand the onward movement only by supposing that it is slightly vermicular, or that the tip alternately straightens itself a little and then again curls inwards, thus dragging itself onwards by an insensibly slow, alternate movement, which may be compared to that of a strong man suspended by the ends of his fingers to a horizontal pole, who works his fingers onwards until he can grasp the pole with the palm of his hand. However this may be, the fact is certain that a tendril which has caught a round stick by its extreme point can work itself onwards until it has passed twice or even thrice round the stick, and has permanently grasped it.

Hanburya Mexicana.—The young internodes and tendrils of this anomalous member of the family revolve in the same manner and at about the same rate with the *Echinocystis*. The stem does not twine, but can ascend an upright stick by the aid of its tendrils. The concave tip of the tendril is very sensitive; after rapidly coiling into a loop from a single touch, it straightened itself in 50m. The tendril, when in full action, stands vertically up, with the young projecting extremity of the shoot thrown a little on one side out of the way; but the tendril bears near its base, on the inner side, a short branch, which projects out at right angles, like a spur, with the terminal half bowed a little downwards. Hence, as the main vertical branch of the tendril revolves, the spur, from its position and rigidity, cannot pass over the extremity of the shoot in the same curious manner as do the three branches of the tendril of the *Echinocystis* by stiffening themselves at the proper point, but is pressed laterally against the young shoot in one part of the revolving course, and in another part is carried only a little

way from it. Hence the sweep of the lower part of the tendril of the *Hanburya* is much restricted. Here a nice case of co-adaptation comes into play: in all the other tendrils observed by me the several branches become sensitive at the same period; had this been the case with the *Hanburya*, the rectangular spur-like branch being pressed, during the revolving movement, against the projecting end of the shoot, would infallibly have seized it in a highly injurious manner. But the main tendril, after revolving for a time in a vertical position, spontaneously bends downwards; and this, of course, raises the rectangular branch, which itself also curves upwards; so that by these combined movements the spur-like branch rises above the projecting end of the shoot, and can now move freely without touching it; then, and not until then, it first becomes sensitive.

The tips of both branches, when they come into contact with a stick, grasp it like any ordinary tendril. In a few days afterwards the inferior surface swells and becomes developed into a cellular layer, which adapts itself closely to the wood, and firmly adheres to it. This layer is analogous to the adhesive disks formed by the tips of the tendrils in some species of *Bignonia*, but in the *Hanburya* the layer is developed along the terminal portion of the tendril, sometimes for a length of $1\frac{3}{4}$ inch, but not at the extreme tip. The layer is white, whilst the tendril is green, and near the tip it could sometimes be seen to be thicker than the tendril itself; it generally spreads a little beyond the sides of the tendril, and its edge is fringed with free elongated cells, which have enlarged globular or retort-shaped heads. This cellular layer apparently secretes some resinous cement; for its adhesion to the wood was not lessened by immersion for 24 h. in alcohol or water, but was quite loosened by the action during the same period of ether and turpentine. After the tendril has once firmly coiled itself round a stick, it is difficult to imagine of what use the formation of the adhesive cellular layer can be. Owing to the spiral contraction, which ensues after a time, whether or not the tendril has clasped any object, it was never able to remain, excepting in one instance, in contact with a thick post or a nearly flat surface; if it could have become attached to such objects by means of the adhesive cellular layer, this layer would evidently have been of service to the plant. I hear from Dr. Hooker that several other Cucurbitaceous plants have adherent tendrils.

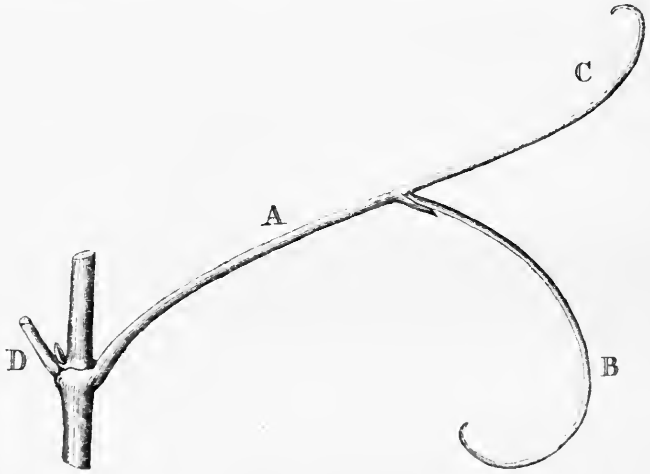
Of other Cucurbitaceæ, I observed in *Bryonia dioica*, *Cucurbita ovifera*, and *Cucumis sativa*, that the tendrils were sensitive and

revolved; in the latter plant, Dutrochet* saw the movement of the tendril reversed; but whether the internodes as well as the tendrils revolve in these several species I did not observe. In *Anguria Warscewiczii*, however, the internodes, though thick and stiff, do revolve: in this plant the lower surface of the tendril, some time after clasping a stick, produces a coarsely cellular layer or cushion, fitting the wood, like that formed by the tendril of the *Hanburya*; but it was not in the least adhesive. In *Zanonia Indica*, which belongs to a different tribe of the family, both the forked tendrils and the internodes revolved, in periods between 2 h. 8 m. and 3 h. 35 m., moving against the sun.

VITACEÆ.—In this family and in the two following, namely, the Sapindaceæ and Passifloraceæ, the tendrils are modified flower-peduncles; so that they are axial in their nature. In this respect they differ from those of all the first described families, but perhaps not from those of the Cucurbitaceæ. The homological nature, however, of a tendril seems to make no difference in its action.

Vitis vinifera.—The tendril is thick and of great size; one from

Fig. 9.



Tendril of the Vine.

A. Peduncle of tendril.
B. Longer branch, with a scale at its base.
C. Shorter branch.
D. Petiole of opposite leaf.

a vine not growing vigorously out of doors, measured 16 inches in length. It consists of a peduncle (A), bearing two branches

* Comptes Rendus, tom. xvii. p. 1005.

which diverge equally from it. One of the branches (B) has a scale at its base, and is always, as far as I have seen, longer than the other, and very often bifurcates. The several branches when rubbed become curved, and subsequently straighten themselves. After a tendril has clasped any object by its extremity, it contracts spirally; but this does not occur (Palm, S. 56) when no object has been seized. The tendrils move spontaneously from side to side; and on a very hot day one made two elliptical revolutions at an average rate of 2 h. 15 m. During these movements a coloured line, painted along the convex surface, became first lateral and then concave. The separate branches have independent movements; after a tendril has spontaneously revolved for a time, it bends from the light towards the dark: I do not give this latter statement on my own authority, but on that of Mohl and Dutrochet; Mohl (S. 77) says that in a vine planted against a wall the tendrils point towards it, and in a vineyard generally more or less to the north.

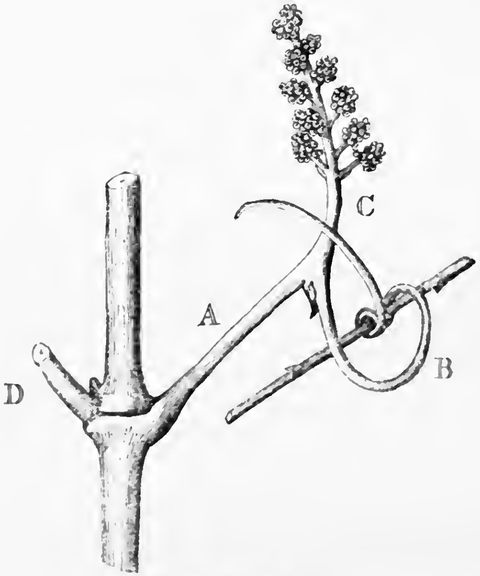
The young internodes spontaneously revolve; but in hardly any other plant have I seen so slight a movement. A shoot faced a window, and I traced its course on the glass during two perfectly calm and hot days; during ten hours on one day it described a spire, representing two and a half ellipses. I likewise placed a bell-glass over a young muscat grape in a hothouse, and it made three or four extremely minute oval revolutions each day: the shoot moved less than half an inch from side to side; and had it not made at least three revolutions during the same day when the sky was uniformly overcast, I should have attributed the motion to the varying action of the light. The extremity of the shoot is more or less bent downwards; but the extremity never reverses its curvature, as so generally occurs with twining plants.

Various authors (Palm, S. 55; Mohl, S. 45; Lindley, &c.) believe that the tendrils of the vine are modified flower-peduncles. I here give a drawing (fig. 10) of the ordinary state of a flower-peduncle in bud: it consists of the "common peduncle" (A); of the "flower-tendril" (B), which is represented as having caught a twig; and of the "sub-peduncle" (C) bearing the flower-buds. The whole peduncle moves spontaneously, like a true tendril, but in a less degree, and especially when the sub-peduncle (C) does not bear many flower-buds. The common peduncle (A) has not the power of clasping a support, nor has the corresponding part in the true tendril. The flower-tendril (B) is always longer than the sub-peduncle (C), and has a scale at its base; it sometimes

bifurcates, and therefore corresponds in every detail with the longer scale-bearing branch (B, fig. 9) of the true tendril. It is, however, inclined backwards from the sub-peduncle (C), or stands at right angles with it, and is thus adapted to aid in carrying the future bunch of grapes. The flower-tendril (B), when rubbed, curves and subsequently straightens itself; and it can, as shown in the drawing, securely clasp a support. I have seen an object as soft as a young vine-leaf caught by one.

The lower and naked part of the sub-peduncle (C) is likewise

Fig. 10.



Flower of the Vine.

A. Common Peduncle.
B. Flower-tendril, with a scale at its base.
C. Sub-Peduncle.
D. Petiole of opposite leaf.

slightly sensitive to a rub, and I have seen it distinctly bent round a stick and even partly round a leaf with which it had come into contact. That the sub-peduncle has the same nature as the corresponding branch of the ordinary tendril is well shown when it bears only a few flowers; for in this case it becomes less branched, increases in length, and gains both in sensitiveness and in the power of spontaneous movement. I have twice seen sub-peduncles (C), bearing only from thirty to forty flower-buds, which had be-

come considerably elongated and had completely wound round sticks, exactly like true tendrils. The whole length of another sub-peduncle bearing only eleven flower-buds quickly became curved when slightly rubbed; but even this scanty number of flowers rendered the stalk less sensitive than the other branch, that is, the flower-tendril; for the latter after a lighter rub became curved in a greater degree and more quickly than the sub-peduncle with its few flowers. I have seen a sub-peduncle thickly covered with flower-buds, but with one of the higher lateral branchlets bearing from some cause only two buds, and this one branchlet had become much elongated and had spontaneously caught hold of an adjoining twig; in fact, it formed a little tendril. The increase of length in the sub-peduncle (C) with the decreasing number of its flower-buds is a good instance of the law of compensation. Hence it is that the whole ordinary tendril is longer than the whole flower-peduncle; thus, on one and the same plant, the longest flower-peduncle (measured from the base of the common peduncle to the tip of the flower-tendril) was $8\frac{1}{2}$ inches in length, whilst the longest tendril was nearly double this length, namely 16 inches.

The gradation from the ordinary state of the flower-peduncle, as represented in the drawing (fig. 10), to that of the true tendril (fig. 9) is perfect. We have seen that the sub-peduncle (C), whilst still bearing from thirty to forty flower-buds, may become somewhat elongated and partially assume all the characters of the corresponding branch of the true tendril. From this state we can trace every stage till we come to a full-sized common tendril, bearing on the branch which corresponds with the sub-peduncle one single flower-bud! Hence there can be no doubt that the tendril is a modified flower-peduncle.

Another kind of gradation well deserves notice. The flower-tendril (B, fig. 10) sometimes produces a few flower-buds; I found thirteen and twenty-two on two flower-tendrils on a vine growing against my house; in this state they retain their characteristic qualities of sensitiveness and spontaneous movement, but in a somewhat lessened degree. On vines in hothouses, so many flowers are occasionally produced by the flower-tendrils that a double bunch of grapes is the result; and this is technically called by gardeners a "cluster." In this state the whole bunch of flowers presents scarcely any resemblance to a tendril; and, judging from the facts already given, it would probably possess little power of clasping a support, or of spontaneous movement. Such flower-peduncles closely resemble in structure those borne

by the next genus, *Cissus*. This genus, as we shall immediately see, produces well-developed tendrils and ordinary bunches of flowers; but there is no gradation between the two states. If the genus *Vitis* were unknown, the boldest believer in the modification of species would never, I suppose, have surmised that the same individual plant, at the same period of growth, would have yielded every possible gradation between ordinary flower-stalks for the support of the flowers and fruit, and tendrils used exclusively for climbing. But the vine clearly gives us this case; and it seems to me as striking and curious an instance of transition as can well be conceived.

Cissus discolor.—The young shoots show no more movement than can be accounted for by daily variations in the action of the light. The tendrils, however, revolve with much regularity, following the sun, and, in the plants observed by me, swept circles of about 5 inches in diameter. Five circles were completed in the following times:—4 h. 45 m., 4 h. 50 m., 4 h. 45 m., 4 h. 30 m., and 5 h. The same tendril continues revolving during three or four days. The tendrils are from $3\frac{1}{2}$ to 5 inches in length; they are formed of a long foot-stalk, bearing two short branches, which in old plants again bifurcate. The two branches are not of quite equal length; and, as with the vine, the longer one has a scale at its base. The tendril stands vertically upwards; the extremity of the shoot is bent abruptly downwards; and this position is probably of service in keeping it out of the way of the revolving tendril.

The two branches whilst young are highly sensitive; for I found a touch with a pencil so gentle as only just to move the tendril which was borne at the end of a long flexible shoot, sufficed to cause it to become perceptibly curved in four or five minutes; the tendril became straight again in rather above one hour. A loop of soft thread weighing one-seventh of a grain was thrice tried, and caused the tendrils to become curved in 30 or 40 m.: half this weight produced no effect. The long foot-stalk is much less sensitive, for slight rubbing produced no effect; but prolonged contact with a stick caused it to bend. The two terminal branches are sensitive on all sides; if a number of tendrils be just touched on different sides, two branches of the one on their inner sides, two on their outer sides, or both branches on the same side, in about a quarter of an hour they present a curiously different appearance. If a branch be touched at the same time with equal force on opposite sides, both sides are equally stimulated and there is no movement. At the beginning of my work, and before

examining this plant, I had observed only those tendrils which are sensitive on one side, and these when lightly pressed between the finger and thumb become curved; but on thus pinching many times the tendrils of this *Cissus* no curvature ensued, and I was at first falsely led to infer that they were not at all sensitive to a touch.

Cissus antarcticus.—The tendrils on a young plant were thick and straight, with the tips a little curved; when the concave surface was rubbed with some force they very slowly became curved, and subsequently became straight again. Hence they are much less sensitive than the tendrils of the last species; but they made two revolutions, following the sun, rather more rapidly, viz. in 3 h. 30 m. and 4 h. The internodes do not revolve.

Ampelopsis hederacea, or *Virginian Creeper.*—In this plant also the internodes do not move more than apparently can be accounted for by the varying action of the light. The tendrils are from 4 to 5 inches in length; the main stem sends off several lateral branches, which have their tips curved, as may be seen in fig. 11, A. They exhibit no true spontaneous revolving movement, but turn, as was long ago observed by Andrew Knight*, from the light to the dark. I have seen several tendrils move through an angle of 180° to the dark side of a case in less than 24 hours; but the movement is sometimes very much slower. The several lateral branches often move independently of each other, and sometimes irregularly, without any apparent cause. These tendrils are less sensitive to a touch than any others observed by me: by gentle but repeated rubbings with a twig, the lateral branches, but not the main stem, became in the course of three or four hours slightly curved; but they seemed to have hardly any power of again straightening themselves. The tendrils of a plant which crawled over a large box-tree clasped several of the branches. But I have repeatedly seen the tendrils come into contact with sticks, and then withdraw from them. When they meet with a flat surface of wood, or a wall (and this is evidently what they are adapted for), they turn all their branches towards it, and, spreading them widely apart, bring their hooked tips laterally into contact with it. In effecting this, the several branches, after touching the surface, often rise up, place themselves in a new position, and again come down into contact with it.

In the course of about two days after a tendril has arranged its branches so as to press on any surface, the curved tips swell, become bright red, and form on their under-sides the well-known

* Trans. Phil. Soc. 1812, p. 314.

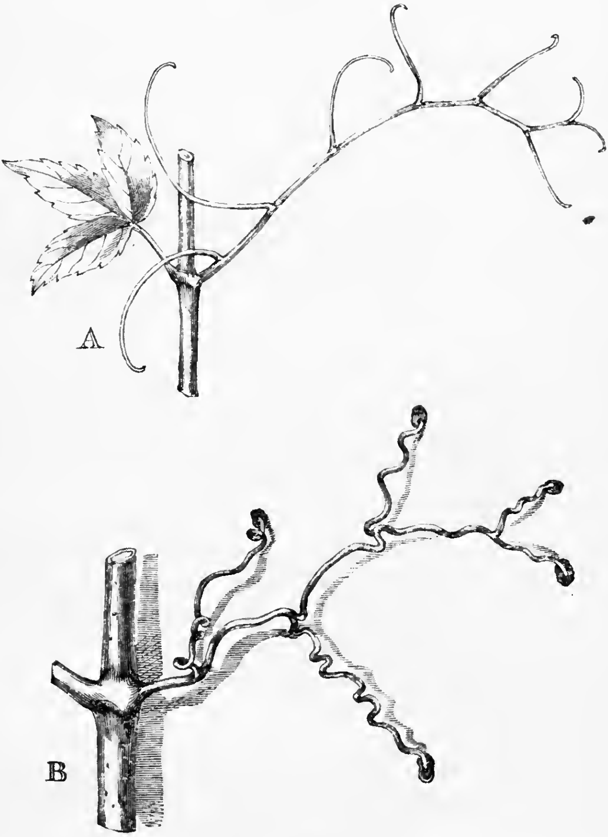
little disks or cushions, which adhere firmly to the surface. In one case these tips became slightly swollen in 38 h. after coming into contact with a brick; in another case they were considerably swollen in 48 h., and in an additional 24 h. they were firmly attached to a smooth board; and lastly, the tips of a younger tendril not only swelled but became attached to a stuccoed wall in 42 h. These adhesive disks resemble, except in colour and in being larger, those of *Bignonia capreolata*. When they were developed in contact with a ball of tow, fibres were separately enveloped, but not in so effective a manner as with *B. capreolata*. Disks are never developed, as far as I have seen, without the stimulus of at least temporary contact with some object. They are generally first formed on one side of the curved tip, the whole of which often becomes so much changed, that a line of green unaltered tissue can be traced only along the concave surface. When, however, a tendril has clasped a cylindrical stick, an irregular rim or disk is formed along the inner surface at some little distance from the curved tip; this was also observed (S. 71) by Mohl. The disks consist of enlarged cells, with smooth projecting hemispherical surfaces, coloured red, and at first gorged with fluid (see section given by Mohl, S. 70), but they ultimately become woody.

As the disks can almost immediately adhere firmly to such smooth surfaces as planed and painted wood, or to the polished leaf of the ivy, this alone would render it probable that some cement is secreted, as has been asserted to be the case (quoted by Mohl, S. 71) by Malpighi. I removed a number of disks formed during the previous year from a stuccoed wall, and placed them in warm water, diluted acetic acid and alcohol during many hours; but the attached grains of silex were not loosened: immersion in sulphuric ether for 24 h. much loosened them; but warmed essential oils (I tried oil of thyme and peppermint) in the course of a few hours completely released every atom of stone. This seems to prove that some resinous cement is secreted; the quantity secreted, however, must be small; for when a plant ascended a thinly whitewashed wall, the disks adhered firmly to the whitewash; but as the cement never penetrated the thin layer, they were easily withdrawn, together with little scales of the whitewash. It must not be supposed that the attachment is by any means exclusively effected by the cement; for the cellular outgrowth completely envelopes every minute and irregular projection, and insinuates itself into every crevice.

A tendril which has not become attached to any body, does not

contract spirally; and in course of a week or two shrinks into the finest thread, withers and drops off. An attached tendril, on the other hand, contracts spirally, and thus becomes highly elastic; so that when the main foot-stalk is pulled, the strain is equally distributed to all the attached disks. For a few days after the

Fig. 11.



Ampelopsis hederacea

A. Tendril, with the young leaf.

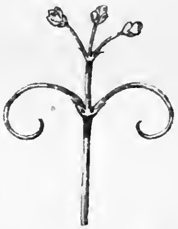
B. Tendril, several weeks after its attachment to a wall, with the branches thickened and spirally contracted, and with the extremities developed into disks. The unattached branches have withered and dropped off.

attachment of the disks, the tendril remains weak and brittle, but it rapidly increases in thickness and acquires great strength: during the following winter it ceases to live, but remains firmly attached to the stem and to the surface of attachment. In the

accompanying diagram we may compare the differences of a tendril (B) some weeks after attachment to a wall, with one (A) from the same plant, fully grown but unattached. That the change in the nature of the tissues of the tendril, as well as the act of spiral contraction, is consequent on the formation of the disks, is well shown by any lateral branches which have not become attached; for these in a week or two wither and drop off, in the same manner as does a whole tendril when unattached. The gain in strength and durability in a tendril after its attachment is something wonderful. There are tendrils now adhering to my house which are still strong and have been exposed to the weather in a dead state for fourteen or fifteen years. One single lateral branchlet of a tendril, estimated to be at least ten years old, was still elastic and supported a weight of exactly two pounds. This tendril had five disk-bearing branches of equal thickness and of apparently equal strength; so that this one tendril, after having been exposed during ten years to the weather, would have resisted a strain of ten pounds!

Sapindaceæ.—*Cardiospermum halicacabum.*—In this family, as in the last, the tendrils are modified flower-peduncles. In our present plant there are no organs exclusively used for climbing like ordinary tendrils; but the two lateral branches of the main flower-peduncle have been converted into a pair of tendrils, corresponding with the single "flower-tendril" of the common vine. The main peduncle is thin, stiff, and from 3 to $4\frac{1}{2}$ inches in length. Near the summit, above two little bracts, it divides into three branches. The middle one divides and redivides, and bears the flowers; ultimately it grows half as long again as the two other modified branches. These latter are the tendrils; they are at first thicker and longer than the middle branch, but never become more than an inch in length. They taper to a point and are flattened, with the lower clasping surface destitute of hairs. At first they project straight up; but soon diverging, they spontaneously curl downwards so as to become symmetrically and elegantly hooked, as represented in the diagram. They are now, whilst the flower-buds are still small, ready for action.

Fig. 12.



C. halicacabum.

Upper part of the flower-peduncle with its two tendrils.

The two or three upper young internodes steadily revolve; those on one plant made two circles, against the course of the sun,

in 3 h. 12 m.; in a second plant the same course was followed, and the two were completed in 3 h. 41 m.; in a third plant the internodes followed the sun, and made two circles in 3 h. 47 m. The average rate of these six revolutions was 1 h. 46 m. The stem shows no tendency to twine spirally round a support; but the allied tendril-bearing genus *Paullinia* is said (Mohl, S. 4) to be a twiner. By the revolving movement, the flower-peduncles, which stand up above the end of the shoot, are carried round and round; but when the internodes were securely tied, the long and thin peduncles themselves were seen to be in continued and sometimes rapid movement from side to side. They swept a wide space, but only occasionally moved in a moderately regular elliptical course. By these combined movements one of the two short hooked tendrils, sooner or later, catches hold of some twig or branch, and then it curls round and securely grasps it. These tendrils are, however, but slightly sensitive; for by rubbing their under surfaces only a slight movement was slowly produced. I hooked a tendril on to a twig; and in 1 h. 45 m. it had curved considerably inwards; in 2 h. 30 m. it formed a ring; and in from 5 to 6 hours from being first hooked, it closely grasped the stick. A second tendril acted at nearly the same rate; but I observed one that took 24 hours before it curled twice round a thin twig. Tendrils which have caught nothing spontaneously curl, after the interval of several days, closely up into a helix. Those which have curled round some object soon become a little thicker and tougher. The long and thin main peduncle, though spontaneously moving, is not sensitive and never clasps a support. It never contracts spirally. Such contraction would apparently have been of service to the plant in climbing; nevertheless it climbs pretty well without this aid. The seed-capsules, though light, are of enormous size (hence its English name of Balloon-vine), and as two or three are carried on the same peduncle, the tendrils arising close to them may possibly be of service in preventing these balloons from being dashed to pieces by the wind. In the hothouse they served simply for climbing.

The position of the tendrils alone suffices to show their homological nature; but in two instances one of the tendrils produced at its tip a flower; this, however, did not prevent the tendril acting properly and curling round a twig. In a third case the two lateral branches which ought to have existed as tendrils, both produced flowers like the central branch, and had quite lost their tendril-structure.

I have only seen, but was not enabled carefully to observe, one other climbing Sapindaceous plant, namely *Paullinia.* It was not in flower, yet thus it bore fine long forked tendrils, differing from *Cardiospermum.* So that, in its tendrils, *Paullinia* apparently bears the same relation to *Cardiospermum* that *Cissus* does to *Vitis.*

Passifloraceæ.—After reading the discussion and facts given by Mohl (S. 47) on the nature of the tendrils in this family, no one can doubt that they are modified flower-peduncles. The tendrils and true flower-peduncles rise close side by side; and my son, Mr. W. E. Darwin, made sketches for me of their earliest state of development in the hybrid *P. floribunda.* The two organs at first appear as a single papilla which gradually divides; so that I presume the tendril is a modified branch of a single flower-peduncle. My son found one very young tendril surmounted by traces of floral organs, exactly like those on the summit of the true flower-peduncle at the same early age.

Passiflora gracilis.—This well-named, elegant, annual species differs from the other members of the group, observed by me, in the young internodes having the power of revolving. It exceeds all other climbing plants in the rapidity of its movements, and all tendril-bearers in the sensitiveness of its tendrils. The internode which carries the upper active tendril and which likewise carries one or two young immature internodes, made three revolutions, following the sun, at an average rate of 1 h. 4 m.; it then made, the day becoming very hot, three other revolutions at an average rate of between 57 and 58 m.; so that the average rate of all six revolutions was 1 h. 1 m. The apex of the tendril described ellipses, sometimes narrow and long, sometimes broad and long, with their longer axes inclined in slightly different directions. The plant can ascend a thin upright stick by the aid of its tendrils; but the stem is too stiff for it to twine spirally round a stick, even when not interfered with by the tendrils, which had been successively pinched off at an early age.

When the stem was secured, the tendrils were seen to revolve in nearly the same manner and at the same rate as the internodes. The tendrils are very thin, delicate, and straight, with the exception of the tips, which are a little curved; they are from 7 to 9 inches in length. A half-grown tendril was not sensitive; but when nearly full-grown they are extremely sensitive. A single delicate touch on the concave surface of the tip soon caused it to curve, and in two minutes it formed an open helix. A loop of soft thread weighing $\frac{1}{32}$nd of a grain (equal to only two

millegrammes) placed most gently on the tip, thrice plainly caused it to curve; as twice did a bent bit of thin platina wire weighing $\frac{1}{50}$th of a grain; but this latter weight, when left suspended, did not suffice to cause permanent curvature. These trials were made under a bell-glass, so that the loops of thread and wire were not agitated by the wind. The movement after a touch is very rapid: I took hold of the lower part of several tendrils and then touched with a thin twig their concave tips, and watched them carefully through a lens; the tips plainly began to bend in the following times—31, 25, 32, 31, 28, 39, 31, and 30 seconds; so that the movement was generally perceptible in half a minute after the touch, but once plainly in 25 seconds. One of the tendrils which thus became bent in 31 seconds had been touched two hours previously and had coiled into a helix; thus in this interval it had straightened itself and had perfectly recovered its sensibility.

I repeated the experiment made on the *Echinocystis*, and placed several plants of this *Passiflora* so close together that the tendrils were repeatedly dragged over each other; but no curvature ensued. I likewise repeatedly flirted small drops of water from a brush on many tendrils, and syringed others so violently that the whole tendril was dashed about, but they never became curved. The impact from the drops of water on my hand was felt far more plainly than that from the loops of thread (weighing $\frac{1}{32}$nd of a grain) when allowed to fall on it; and these loops, which caused the tendrils to become curved, had been placed most gently on them. Hence it is clear, either that the tendrils are habituated to the touch of other tendrils and to that of drops of rain, or that they are sensitive only to prolonged though excessively slight pressure. To show the difference in the kind of sensitiveness in different plants and likewise to show the force of the syringe used, I may add that the lightest jet from it instantly caused the leaves of a *Mimosa* to close; whereas the loop of thread weighing $\frac{1}{32}$nd of a grain, when rolled into a ball and gently placed on the glands at the bases of the leaflets of the *Mimosa*, caused no action. Had I space, I could advance much more striking cases in plants both belonging to the same family, of one being excessively sensitive to the lightest pressure if prolonged, but not to a brief impact; and of another plant equally sensitive to impact, but not to slight though prolonged pressure.

Passiflora punctata.—The internodes do not move; but the tendrils regularly revolve. One that was about half-grown and very sensitive made three revolutions, opposed to the course of

the sun, in 3 h. 5 m., 2 h. 40 m., and 2 h. 50 m.; perhaps it might have travelled more quickly when nearly full-grown. The plant was placed in front of a window, and I ascertained that, as with twining stems so with these tendrils, the light accelerated the movement in one direction and retarded it in the other; the semicircle towards the light being performed in one instance in 15 m., and in a second instance in 20 m. less time than that required by the semicircle towards the dark end of the room. Considering the extreme tenuity of these tendrils, the action of the light on them is remarkable. The tendrils are long, and, as just stated, very thin, with the tip slightly curved or hooked. The concave side is extremely sensitive to a touch—even a single touch causing it to curl inwards; it subsequently straightens itself, and is again ready to act. A loop of soft thread weighing $\frac{1}{14}$th of a grain caused the extreme tip to bend; at another time I tried to hang the same little loop on an inclined tendril, but three times it slid off; yet this extraordinarily slight degree of friction sufficed to make the tip curl. The tendril, though so sensitive, does not move very quickly after a touch, no conspicuous change being observable until 5 or 10 m. had elapsed. The convex side of the tip is not sensitive to a touch or to a suspended loop of thread. In one instance I observed a tendril revolving with the convex side of the tip forwards, and on coming into contact with a stick it merely scraped up and past the obstacle and was not able to clasp it; whereas tendrils revolving with the concave side of their tips forward promptly seize any object in their path.

Passiflora quadrangularis.—This is a very distinct species. The tendrils are thick, long, and stiff; they are sensitive to a touch only towards the extremity and on the concave surface. When a stick was so placed that the middle of the tendril came into contact with it, no curvature ensued. In the hothouse a tendril made two revolutions each in 2 h. 22 m.; in my cooler study one was completed in 3 h., and a second in 4 h. The internodes do not revolve; nor do those of the hybrid *P. floribunda.*

Tacsonia manicata.—Here again the internodes do not revolve. The tendrils are moderately thin and long; one made a narrow ellipse in 5 h. 20 m., and the next day a broad ellipse in 5 h. 7 m. The extremity being lightly rubbed on the concave surface, became just perceptibly curved in 7 m., clearly curved in 10 m., and hooked in 20 m.

We have seen that the tendrils in the last three families, namely

the Vitaceæ, Sapindaceæ, and Passifloraceæ, are modified flower-peduncles. This is likewise the case, according to De Candolle (as quoted by Mohl), with the tendrils of *Brunnichia*, one of the Polygonaceæ. In two or three species of *Modecca*, one of the Papayaceæ, the tendrils, as I hear from Prof. Oliver, occasionally bear flowers and fruit; so that at least they are axial in their nature.

Spiral contraction of Tendrils.—This movement, which shortens the tendrils and renders them elastic, commences in half a day or in a day or two after their extremities have caught some object. There is no such movement in any leaf-climber, with the exception of an occasional trace of it in the petioles of *Tropæolum tricolorum*. On the other hand, it occurs with all tendrils after they have seized some object, with the few following exceptions,—namely *Corydalis claviculata*, but then this plant might still be called a leaf-climber; *Bignonia unguis* and its close allies, and the *Cardiospermum*; though these tendrils are so short that the contraction could hardly take place, and would be quite superfluous; and *Smilax aspera*, the tendrils of which, though rather short, offer a more marked exception. In the *Dicentra*, whilst young, the tendrils are short and do not contract spirally, but only become slightly flexuous; the longer tendrils, however, borne by older plants contract spirally. I have seen no other exceptions to the rule that all tendrils, after clasping by their extremities a support, contract spirally. When, however, the tendril of any plant of which the stem happens to be immoveably fixed, catches some fixed object, it does not contract, simply because it cannot; this, however, rarely occurs. In the common Pea only the lateral branches, and not the central stem of the tendril, contract; and with most plants, such as the Vine, Passiflora, Bryony, the basal portion never contracts into a spire.

I have said that in *Corydalis claviculata* the end of the leaf or the tendril (for this part may be indifferently thus designated) does not contract into a spire. The branchlets, however, of the tendril, after they have wound round thin twigs, become deeply sinuous or zigzag; and this may be the first indication of the process of spiral contraction. Moreover the whole end of the petiole or tendril, if it seizes nothing, ultimately bends abruptly downwards and inwards, showing that its inferior surface contracts; and this may be confidently looked at as the first indication of the power of spiral contraction. For with all true tendrils when they contract spirally, it is the lower surface, as Mohl (S. 52) has remarked, which contracts. If the inferior surface of

the extremity of a free tendril were to contract quite regularly, it would roll itself up into a flat helix, as occurs with the *Cardiospermum*; but if it were to contract in the least on one side, or if the basal portion were first to contract (as does occur), the long free extremity could not be rolled up within the basal part, or if the tip were held during the contraction, as when a tendril has caught some object,—in all these cases the inevitable result would be the formation not of a helix, but of a spire, such as free and caught tendrils form in the act of contraction.

Tendrils of many kinds of plants, if they catch nothing, contract after an interval of several days or weeks into a close spire; but in these cases the movement takes place after the tendril has lost its revolving power and has partly or wholly lost its sensibility, and hangs downwards; this, as we shall presently see, is a quite useless movement. The spiral contraction of unattached tendrils is a much slower process than that of attached tendrils: young tendrils which have caught a support and are spirally contracted may be constantly seen on the same stem with much older tendrils, unattached and uncontracted. In the *Echinocystis* I have seen a tendril with the two lateral branches clasped to twigs and contracted into beautiful spires, whilst the main branch which had caught nothing remained for many days afterwards uncontracted. In this plant I once observed a main branch after it had caught a stick become spirally flexuous in 7 h., and spirally contracted in 18 h. Generally the tendrils of the *Echinocystis* begin to contract in from 12 h. to 24 h. after catching something; whilst its unattached tendrils do not begin to contract until two or three or even more days have elapsed after the revolving movement has ceased. I will give one other case: a full-grown tendril of *Passiflora quadrangularis* which had caught a stick began in 8 h. to contract, and in 24 h. several spires were formed; a younger tendril, only two-thirds grown, showed the first trace of contraction in two days after clasping a stick, and in two additional days had formed several spires; hence, apparently, the contraction does not begin in a tendril until it is grown to nearly its full length. Another young tendril of about the same age and length as the last did not catch any object; it acquired its full length in four days; in six additional days it first became flexuous, and in two more days had formed one complete spire. This first spire was formed towards the basal end of the tendril, and the contraction steadily but slowly progressed towards the apex; but the whole was not closely wound up until 21 days had

elapsed from the first observation, that is until 17 days after the tendril was fully grown.

The best proof of the intimate connexion between the spiral contraction of a tendril and the previous act of clasping a support, is afforded by those tendrils which, when caught, invariably contract into a spire, whilst as long as they remain unattached they continue straight, though dependent, and thus wither and drop off. The tendrils of *Bignonia*, which are modified leaves, thus behave, as do the tendrils of the three genera of Vitaceæ, and these are modified flower-peduncles. The tendrils, however, of *Eccremocarpus*, which is allied to *Bignonia*, contract spirally even when they have caught nothing. The uncaught tendrils of the *Cardiospermum*, and to a certain extent those of the *Mutisia*, roll themselves up not into a spire, but into a helix.

The spiral contraction which ensues after a tendril has caught a support is of high service to all tendril-bearing plants; hence its almost universal occurrence with plants of widely different orders. When a shoot is inclined and its tendril has caught an object above, the spiral contraction drags up the shoot. When the shoot is upright, the growth of the internodes, subsequently to the tendrils having seized some object above, would slacken the stem were it not for the spiral contraction, which draws up the internodes as they increase in length. Thus there is no waste of growth, and the stretched stem ascends by the shortest course. We have seen in the *Cobæa*, when a terminal branchlet of the tendril has caught a stick, how well the spiral contraction of its branches successively brings them one after the other into contact with the stick, until the whole tendril has grasped it in an inextricable knot. When a tendril has caught a yielding object, this is sometimes enveloped and still further secured by the spiral folds, as I have seen with *Passiflora quadrangularis*; but this action is of little importance.

A far more important service rendered by the spiral contraction is that the tendrils are thus made highly elastic. As was previously remarked under *Ampelopsis*, the strain is thus equally distributed to the several attached branches of a branched tendril; and this must render the whole tendril far stronger, as branch after branch cannot separately break. It is this elasticity which saves both branched and simple tendrils from being torn away during stormy weather. I have more than once gone on purpose during a gale to watch a Bryony growing in an exposed hedge, with its tendrils attached to the surrounding bushes; and as the

thick or thin branches were tossed to and fro by the wind, the attached tendrils, had they not been excessively elastic, would instantly have been torn off and the plant thrown prostrate. But as it was, the Bryony safely rode out the gale, like a ship with two anchors down, and with a long range of cable ahead to serve as a spring as she surges to the storm.

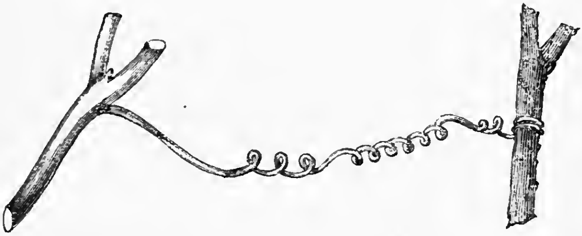
With respect to the exciting cause of the spiral contraction, little can be said. After reading Prof. Oliver's interesting paper * on the hygroscopic contraction of legumes, I allowed a number of different kinds of tendrils to dry slowly, but no spiral contraction ensued; nor did this occur with the tendrils of the Bryony when placed in water, diluted alcohol, and syrup of sugar. We know that the act of clasping a support leads to a change in the nature of their tissues; and we call this a vital action, and so we must call the spiral contraction. The contraction is not related to the spontaneous revolving power, for it occurs in tendrils, such as those of *Lathyrus grandiflorus* and *Ampelopsis hederacea*, which do not revolve. It is not necessarily related to the curling of the tips round a support, as we see in the case of the *Ampelopsis* and *Bignonia capreolata*, in which the development of the adherent disks suffices to induce the contraction. Yet it certainly seems to stand in some close relation to the curling or clasping movement due to contact with a support; for not only does it soon follow this act, but the spiral contraction generally begins close to the curled extremity, and travels down towards the base, as if the whole tendril tried to imitate the movement of its extremity. If, however, a tendril be very slack, the whole length seems to become almost simultaneously at first flexuous and then spiral. The spiral contraction of a tendril when unattached cannot serve any of the useful ends just described; it does not occur with many kinds of tendrils which contract when attached; and when it does occur, it supervenes, as we have seen, only after a considerable interval of time. It may almost be likened to certain instinctive or habitual movements performed by animals under circumstances rendering them manifestly useless.

When an uncaught tendril contracts spirally, the spire always runs in the same direction from tip to base. A tendril, on the other hand, which has caught a support by its extremity, invariably becomes twisted in one part in one direction, and in another part in the opposite direction; the oppositely turned spires being

* Trans. Linn. Soc. vol. xxiv. 1864, p. 415.

separated by short straight portions. This curious and symmetrical structure has been noticed by several botanists, but has not been

Fig. 13.



A caught tendril of *Bryonia dioica*, spirally contracted in reversed directions.

explained*. It occurs without exception with all tendrils which after catching any object contract spirally, but is of course most conspicuous in the longer tendrils; it never occurs with uncaught tendrils; and when this appears to have happened, it will be found that the tendril had originally seized some object and had afterwards been torn free. Commonly all the spires at one end of a caught tendril run in one direction, and all those at the other end in the opposite direction, with a single short straight portion in the middle; but I have seen a tendril with the spires alternately turning five times in opposite directions, with straight portions between them; and M. Léon has seen seven or eight such alternations. Whether the spires turn several times in opposite directions, or only once, there are as many turns in the one direction as in the other. For instance, I gathered ten long and short caught tendrils of the Bryony, the longest with 33, and the shortest with only 8 spiral turns; and the number of turns in one direction was in every case the same (within one) as in the opposite direction.

The explanation of this curious little fact is not difficult; I will not attempt any geometrical reasoning, but will give only practical illustrations. In doing this, I shall first have to allude to a point which was almost passed over when treating of Twining-plants. If we hold in our left hand a bundle of parallel strings, we can with our right hand turn these round and round, and imitate the revolving movement of a twining plant, and the strings do not become twisted. But if we now at the same time hold a stick in our left hand, in such a position that the strings become

* See M. Isid. Léon in Bull. Soc. Bot. de France, tom. v. 1858, p. 680.

spirally turned round it, they will inevitably become twisted. Hence a straight coloured line, painted along the internodes of a twining plant before it has wound round a support, becomes twisted or spiral after it has so wound round. I painted a red line on the straight internodes of a *Humulus*, *Mikania*, *Ceropegia*, *Convolvulus*, and *Phaseolus*, and saw it become twisted as the plant wound round a stick. It is possible that the stems of some plants by spontaneously turning on their own axes, at the proper rate and in the proper direction, might avoid becoming twisted; but I have seen no such case.

In the above illustration, the parallel strings were wound round a stick; but this is by no means necessary, for if wound into a hollow coil (as can be done with a narrow slip of elastic paper) there is the same inevitable twisting of the axis. Hence when a tendril, which is free at its end, coils itself into a spire, it must either become twisted along its whole length (and this is a case which I have never seen), or the free extremity must turn round as many times as there are spires formed. It was hardly necessary to observe this fact; but I did so by affixing little paper vanes to the extreme points of the tendrils of the *Echinocystis* and *Passiflora quadrangularis*; and as the tendril contracted itself into successive spires, the vane slowly revolved.

We can now understand the meaning of the spires being invariably turned in opposite directions in those tendrils which, having caught some object, are thus fixed at both ends. Let us suppose a caught tendril to make thirty spiral turns in one direction; the inevitable result will be that it will become thirty times twisted on its own axis. This twisting not only would require considerable force, but, as I know by trial, would burst the tendril before the thirty turns were completed. Such a case never really occurs; for, as already stated, when a tendril has caught a support and has spirally contracted, there are always as many turns in one direction as in the other; so that the twisting of the axis in the one direction is exactly compensated by that in the other. We can further see how the tendency is given to make coils in an opposite direction to those, whether turned to the right or to the left, which are first made. Take a piece of string, and let it hang down with the lower end fixed to the floor; then wind the upper end (holding the string quite loosely) spirally round a perpendicular pencil, and this will twist the lower part of the string; after it has been sufficiently twisted, it will be seen to curve itself into an open spire, with the curves running in an opposite direc-

tion to those round the pencil, and consequently with a straight piece of string between the opposite spires. In short, we have given to the string the regular spiral arrangement of a tendril caught at both ends. The spiral contraction generally begins at the extremity which has clasped a support; and these first-formed spires give a twist to the axis of the tendril, which necessarily inclines the basal part into an opposite spiral curvature. I cannot resist giving one other illustration, though superfluous: when a haberdasher winds up ribbon for a customer, he does not wind it into a single coil; for, if he did, the ribbon would twist itself as many times as there were coils; but he winds it into a figure of eight on his thumb and little finger, so that he alternately takes turns in opposite directions, and thus the ribbon is not twisted. So it is with tendrils, with this sole difference, that they take several consecutive turns in one direction and then the same number in an opposite direction; but in both cases the self-twisting is equally avoided.

Summary on the Nature and Action of Tendrils.—In the concluding remarks I shall have to allude to some points which may be here passed over. In the majority of tendril-bearing genera the young internodes revolve in more or less broad ellipses, like those made by twining plants; but the figures described, when carefully traced, generally form irregular ellipsoidal spires. The rate of revolution in different plants varies from one to five hours, and consequently in some cases is more rapid than with any twining plant, and is never so slow as with those many twiners, which take more than five hours for each revolution. The direction is variable even in the same individual plant. In *Passiflora*, the internodes of only one of the species have the power of revolving. The Vine is the weakest revolver observed by me, apparently exhibiting only a trace of a former power. In the *Eccremocarpus* the movement is interrupted by many long pauses. Some, but very few, tendril-bearing plants can spirally twine up an upright stick. Although the twining-power has generally been lost by tendril-bearers, either from the stiffness or shortness of the internodes, from the size of the leaves, or from other unknown causes, the revolving movement well serves to bring the tendrils into contact with surrounding objects.

The tendrils also have the power of revolving in the same manner and generally at the same rate with the internodes. The movement begins whilst the tendril is young, but is at first slow. In *Bignonia littoralis* even the mature tendrils moved much slower

than the internodes. In all cases the conditions of life must be favourable for the perfect action of the tendrils. Generally both internodes and tendrils revolve together; in other cases, as in *Cissus*, *Cobæa*, and most Passifloræ, the tendrils alone revolve; in other cases, as with *Lathyrus aphaca*, the internodes alone move, carrying with them the motionless tendrils; and, lastly (and this is the fourth possible case), neither internodes nor tendrils spontaneously revolve, as with *Lathyrus grandiflorus* and the *Ampelopsis*. In most Bignonias, in the *Eccremocarpus*, *Mutisia*, and the Fumariaceæ, the petioles as well as the tendrils, together with the internodes, all spontaneously move together.

The tendrils revolve by the curvature of their whole length, excepting the extremity and excepting the base, which parts do not move, or move but little. The movement is of the same nature as that of the revolving internodes. Hence, if a line be painted along that surface which at the time happens to be convex, the line becomes first lateral and then concave, and ultimately again convex. This experiment can be tried only on the thicker tendrils, which are not affected by a thin crust of dried paint. The extremities, however, of the tendrils, which so often are slightly curved or hooked, never reverse their curvature; and in this respect they differ from the extremities of the shoots of twining plants, which not only reverse their curvature, or at least become periodically straight, but curve in a greater degree than the lower portions. But, in fact, the tendril answers to the upper internode of the several revolving internodes of a twining plant; and in the former part of this paper it was explained how the several internodes move together by the whole successively curving to all points of the compass. There is, however, in many cases this unimportant difference, that the curving tendril is separated from the curving internode by a rigid petiole. There is also another difference, namely, that the summit of the shoot, which in itself has no power of revolving, projects above the point from which the tendril arises; but the summit of the shoot is generally thrown on one side, so as to be out of the way of the revolutions swept by the tendril. In those plants in which the terminal shoot is not sufficiently out of the way, the tendril, as we have seen with the *Echinocystis*, as soon as it comes in its revolving course to this point, stiffens and straightens itself, and, rising up vertically, passes over the obstacle.

All tendrils are sensitive, but in very various degrees, to contact with any object, and curve towards the touched side. With

several plants a single touch, so slight as only just to move the highly flexible tendril, is enough to induce curvature. *Passiflora gracilis* has the most sensitive tendrils which I have seen: a bit of platina wire $\frac{1}{50}$th of a grain in weight, gently placed on the concave point, caused two tendrils to become hooked, as did (and this perhaps is a better proof of sensitiveness) a loop of soft, thin cotton thread weighing $\frac{1}{32}$nd of a grain, or about two milligrammes. With the tendrils of several other plants, loops weighing $\frac{1}{16}$th of a grain sufficed. The point of the tendril of the *Passiflora gracilis* distinctly began to move in 25 seconds after a touch. Asa Gray saw movement in the tendrils of the Cucurbitaceous genus, *Sicyos*, in 30 seconds. The tendrils of some other plants, when lightly rubbed, move in a few minutes; in the *Dicentra* in half-an-hour; in the *Smilax* in an hour and a quarter or a half; and in the *Ampelopsis* still more slowly. The curling movement consequent on a single touch continues to increase for a considerable time, then ceases; after a few hours the tendril uncurls itself, and is again ready for action. When very light weights were suspended on tendrils of several plants and caused them to curve, these seemed to become accustomed to so slight a stimulus, and straightened themselves, as if the loops had been removed. It makes no difference, as far as I have seen, what sort of object a tendril touches, with the remarkable exception of drops of water in the case of the extremely sensitive tendrils of *Passiflora gracilis* and of the *Echinocystis*; hence we are led to infer that they have become habituated to showers of rain. As I made no observations with this view on other tendrils, I cannot say whether there are more cases of this adaptation. Moreover adjoining tendrils rarely catch each other, as we have seen with the *Echinocystis* and *Passiflora*, though I have seen this occur with the Bryony.

Tendrils of which the extremities are slightly curved or bowed are sensitive only on the concave surface; other tendrils, such as those of the *Cobœa* (though furnished with minute horny hooks) and those of *Cissus discolor*, are sensitive on all sides. Hence the tendril of this latter plant, when stimulated by a touch of equal force on opposite sides, does not bend. In the tendril of the *Mutisia* the inferior and lateral surfaces are sensitive, but not the upper surface. With branched tendrils, the several branches all act alike; but in the *Hanburya* the lateral spur-like branch does not acquire (for a reason which has been explained) its sensitiveness nearly so soon as the main branch. The lower or basal part of many tendrils is either not at all sensitive or sensitive only

to prolonged contact. Hence we see that the sensitiveness of tendrils is a special and localized capacity, quite independent of the power of spontaneously moving; for the curling of the terminal portion from a touch does not in the least interrupt the spontaneous revolving movement of the lower part. In *Bignonia unguis* and its close allies the petioles of the leaves, as well as the tendrils, are sensitive to a touch.

Twining plants when they come into contact with a stick, curl round it invariably in the direction of their revolving movement; but tendrils curl indifferently to either side, in accordance with the position of the stick and the side which is first touched. The clasping-movement of the extremity apparently is not steady, but vermicular in its nature, as may be inferred from the manner in which the tendrils of the *Echinocystis* slowly crawled round a smooth stick.

As with a few exceptions tendrils spontaneously revolve, it may be asked, Why are they endowed with sensitiveness?—why, when they come into contact with a stick, do they not, like a twining plant, spirally wind round it? One reason may be that in most cases they are so flexible and thin that, when brought into contact with a stick, they would yield, and their revolving movement would not be arrested; they would thus be dragged onwards and away from the stick. Moreover the sensitive extremities have no revolving power, and could not by this means curl round any object. With twining plants, on the other hand, the extremity of the shoot spontaneously bends more than any other part; and this is of high importance to the ascending power of the plant, as may be seen on a windy day. It is, however, possible that the slow movement of the basal and stiffer parts of certain tendrils, which wind round sticks placed in their course, may be analogous to that of twining plants. I doubt this; but I hardly attended sufficiently to this point, and it would be difficult to distinguish between a movement due to extremely dull sensitiveness and that resulting from the arrestment of the lower part together with the continued movement of the terminal part of a tendril.

Tendrils which are only three-fourths grown, and perhaps even when younger, but not whilst extremely young, have the power of revolving and of grasping any object which they may touch. These two capacities generally commence at about the same period, and fail when the tendril is full grown. But in the *Cobæa* and *Passiflora punctata* the tendrils began revolving in a quite useless manner, before they became sensitive. In

the *Echinocystis* they retained their sensitiveness for some time after they had ceased revolving and had drooped downwards; in this position, even if they should seize any object, they could be of little or no use in supporting the stem. It is a rare circumstance thus to be able to detect any imperfection or superfluity in tendrils—organs which are so admirably adapted for the functions which they have to perform; but we see that they are not always absolutely perfect, and it would be rash to assume that any existing tendril has reached the utmost limit of perfection.

Some tendrils have their revolving motion accelerated and retarded in moving to and from the light; others, as with the Pea, seem indifferent to its action; others move from the light to the dark, and this aids them in an important manner in finding a support. In *Bignonia capreolata* the tendrils bend from the light to the dark, like a banner from the wind. In the *Cobæa* and *Eccremocarpus* the extremities alone twist and turn about, so as to bring their finer branches and hooks into close contact with any surface, or into dark crevices and holes. This latter movement is one of the best adapted exhibited by tendrils.

A short time after a tendril (with some rare exceptions) has caught a support, it contracts spirally; but the manner of contraction and the several important advantages thus gained have been so lately discussed, that nothing need be here said on the subject. Again, tendrils soon after catching a support grow much stronger and thicker, and sometimes in a wonderful degree durable; and all this shows how much their internal tissues must change. Tendrils which have caught nothing soon shrink and wither; in some species of *Bignonia* they disarticulate and fall off like leaves in autumn.

Any one who did not closely study tendrils of various kinds would probably infer that their action would always be uniform. This is the case with most kinds of tendrils, of which the extremities simply curl round objects of any moderate degree of thickness, and of various shapes or natures. But *Bignonia* shows us what diversity of action there may be in the tendrils of even closely allied species. In all the nine species of this genus observed by me the young internodes revolved vigorously; as did the petioles of nearly all, but in very unequal degrees; in three of the species the petioles were sensitive to contact; the tendrils of all are sensitive to contact, and likewise revolve, but in some of the species in a very feeble manner. In the first-described unnamed species, the tendrils, in shape like a bird's foot, are of no service

when the stem spirally ascends a thin upright stick, but they can seize any twig or branch lying beneath them ; but when the stem spirally ascends a somewhat thicker stick, a slight degree of sensitiveness in the petioles is brought into play, and they wind their tendrils round the stick. In *B. unguis* and *B. Tweedyana* the sensitiveness, as well as the power of movement, in the petioles is greatly augmented ; and the tendrils and petioles are thus inextricably wound together round thin upright sticks ; but the stem, in consequence, does not twine so well : *B. Tweedyana*, in addition, emits aërial roots which adhere to the stick. In *B. venusta* the tendrils have lost the bird's-foot structure, and are converted into long three-pronged grapnels ; these exhibit a conspicuous power of spontaneous movement ; the petioles, however, have lost their sensitiveness. The stem can spirally twine round an upright stick, and is aided in its ascent by the tendrils alternately seizing the stick some way above and then spirally contracting. In this and all the following species the tendrils spirally contract after seizing any object. In *B. littoralis* and *B. Chamberlaynii* the tendrils, which have the same structure as in *B. venusta*, and the non-sensitive petioles and the internodes all spontaneously revolve. The stem, however, cannot spirally twine, but ascends an upright stick by both tendrils, seizing it above. In *B. littoralis* the tips of the tendrils become developed into adhesive disks. In *B. speciosa* and *B. picta* we have similar powers of movement, but the plant cannot spirally twine round a stick ; it can, however, ascend by clasping it with one or both of its unbranched tendrils, on their own level ; and these exhibit the strange, apparently useless, habit of continually inserting their pointed ends into minute crevices and holes. In *B. capreolata* the stem twines in an imperfect manner ; the much-branched tendrils revolve in a capricious manner, and they have the power of bending in a conspicuous manner from the light to the dark ; their hooked extremities, even whilst immature, crawl into any crevice, or, when mature, seize any thin projecting point ; in both cases they develope adhesive disks, which have the power of enveloping by growth the finest fibres.

In the allied *Eccremocarpus* the internodes, petioles, and tendrils all spontaneously revolve together ; its much-branched tendrils resemble those of *Bignonia capreolata*, but they do not turn from the light ; and their bluntly hooked extremities, which arrange themselves so neatly to any surface, do not form adhesive disks ; they act best when each seizes a few thin stems, like the culms of a grass, which they afterwards draw together by their spiral con-

traction into a firm bundle. In the *Cobæa* the tendrils alone revolve; these are divided into many fine branches, terminating in sharp little hooks, which crawl into crevices, and are turned by an excellently adapted movement to any object that is seized. In the *Ampelopsis*, on the other hand, there is little or no power of revolving in any part: the branched tendrils are but little sensitive to contact; their hooked extremities cannot seize any thin object; they will not even clasp a stick, unless in extreme need of a support; but they turn from the light to the dark, and, spreading out their branches in contact with any nearly flat surface, the disks are developed. These can adhere, by the secretion of some cement, to a wall, or even to a polished surface; and this is more than the disks of the *Bignonia capreolata* can effect.

The formation and rapid growth of these adherent disks is one of the most remarkable peculiarities in the structure and functions of tendrils. We have seen that such disks are formed by two species of *Bignonia*, by the *Ampelopsis*, and, according to Naudin*, by the Cucurbitaceous genus *Peponopsis adhærens*. Their development, apparently in all cases, depends on the stimulus from contact. It is not a little singular that three families so widely distinct as the Bignoniaceæ, Vitaceæ, and Cucurbitaceæ should all have species bearing tendrils with this same remarkable peculiarity. Most tendrils, after they have clasped any object, rapidly increase in strength and thickness throughout their whole length; but some tendrils, when wound round a support either by the middle or the extremity, become swollen at these points in a remarkable manner; thus I have seen the clasped portion of a tendril of the *Bignonia Chamberlaynii* grown twice as thick as the free basal portion, and become wonderfully rigid. In the *Anguria* the lower surface of the tendril, after it has wound round a stick, forms a coarsely cellular layer, which closely fits the wood, but is not adherent; in the *Hanburya* a similar layer is developed, which is adherent; lastly, in the *Peponopsis* adherent disks are formed at the tips of the tendrils. These three last-named genera belong to the Cucurbitaceæ, so that, in this one family, we have a nearly perfect gradation from a common tendril to one that forms an adherent disk at its tip; the one small step which is wanted is a tendril in a state between that of the *Anguria* and *Hanburya*—that is, adherent only in a slight degree or occasionally.

Finally, it may be added that America, which so abounds with arboreal animals, as has lately been insisted on by Mr. Bates,

* Annales des Sc. Nat. Bot. 4th series, tom. xii. p. 89.

likewise, according to Mohl and Palm, abounds with climbing plants; and, of the tendril-bearing plants examined by me, the most admirably constructed come from this grand continent, namely, the several species of *Bignonia*, *Eccremocarpus*, *Cobæa*, and *Ampelopsis*.

Part IV.—Hook-climbers.—Root-climbers.—Concluding Remarks.

Hook-climbers.—In my introductory remarks, I stated that, besides the great class of twining plants, with the subordinate divisions of leaf-climbers and tendril-bearers, there were hook- and root-climbers. I mention the former only to say that with the few which I have examined, namely, *Galium aparine*, *Rubus australis*, and some climbing Roses, there is no spontaneous revolving movement. If indeed they possessed this power, and were capable of twining, such plants would be placed in the previous great class: thus the Hop, which is a twiner, has reflexed hooks as large as those of the *Galium*; some other twiners have stiff reflexed hairs; *Dipladenia* has a circle of blunt spines at the base of its leaves; one tendril-bearing plant alone, as far as I have seen, namely, *Smilax aspera*, is furnished with spines. Some few plants, which apparently depend solely on their hooks, are excellent climbers, as certain Palms in the New and Old Worlds. Even some of the climbing Roses will ascend the walls of a tall house, if covered with a trellis: how this is effected I know not; for the young shoots of one such Rose, when placed in a pot in a window, bent irregularly towards the light during the day and from it during the night, like any other plant; so that it is not easy to understand how the shoots can get under a trellis close to a wall.

Root-climbers.—A good many plants come under this class, and are excellent climbers. One of the most remarkable is the *Marcgravia umbellata*, which in the tropical forests of South America, as I hear from Mr. Spruce, grows in a curiously flattened manner against the trunks of trees, here and there putting forth claspers (roots), which adhere to the trunk, and, if the latter be slender, completely embrace it. When this plant has climbed to the light, it sends out free and rounded branches, clad with sharp-pointed leaves, wonderfully different in appearance from those borne by the stem, as long as it is adherent. This surprising difference in the leaves I have observed in a plant of *M. dubia* in my hothouse. Root-climbers, as far as I have seen, namely, the Ivy (*Hedera*

helix), *Ficus repens*, and *F. barbatus*, have no power of movement, not even from the light to the dark. As previously stated, the *Hoya carnosa* (Asclepiadaceæ) is a spiral twiner, and can likewise adhere by rootlets even to a flat wall; the tendril-bearing *Bignonia Tweedyana* emits roots, which curve half round and adhere to thin sticks. The *Tecoma radicans* (Bignoniaceæ), which is closely allied to many spontaneously revolving species, climbs by rootlets; but its young shoots apparently move about rather more than can be accounted for by the varying action of the light.

I have not closely observed many root-climbers, but can give one curious little fact. *Ficus repens* climbs up walls just like Ivy; when the young rootlets were made to press lightly on slips of glass, they emitted (and I observed this several times), after about a week's interval, minute drops of clear fluid, not in the least milky like that exuded from a wound. This fluid was slightly viscid, but could not be drawn out into threads; it had the remarkable property of not drying. One drop, about the size of half a pin's head, I slightly spread out, and scattered on it some minute grains of sand. The slip of glass was left exposed in a drawer during hot and dry weather, and, if the fluid had been water, it would certainly have dried in one or two minutes; but it remained fluid, closely surrounding each grain of sand, during 128 days: how much longer it would have remained I cannot say. Some other rootlets were left in contact with the glass for about ten days or a fortnight, and the drops of fluid secreted by them were rather larger, and so viscid that they could be drawn out into threads. Some other rootlets were left in contact during twenty-three days, and these were firmly cemented to the glass. Hence we may conclude that the rootlets first secrete a slightly viscid fluid, and that they subsequently absorb (for we have seen that it will not dry by itself) the watery parts, and ultimately leave a cement. When the rootlets were torn from the glass, atoms of yellowish matter were left on it, which were partly dissolved by a drop of bisulphide of carbon; and this extremely volatile fluid was rendered, by what it had dissolved, very much less volatile.

As the bisulphide of carbon has so strong a power of softening indurated caoutchouc*, I soaked in it during a short time many

* Mr. Spiller has recently shown (Chemical Society, Feb. 16, 1865), in a paper on the oxidation of india-rubber, that this substance, when exposed to the air in a fine state of division, gradually becomes converted into brittle, resinous matter, very similar to shell-lac.

rootlets of a plant which had grown up a plaistered wall. Attached to two sets of rootlets on the same branch, I found very many extremely thin threads of a transparent, not viscid, excessively elastic substance, precisely like caoutchouc. These threads, at one end, proceeded from the bark of the rootlet, and at the other end were firmly attached to transparent particles of silex and other hard substances. There could be no mistake in this observation, for I played with the threads for a long time, under the microscope, drawing them out with the dissecting-needles and letting them spring back again. Yet, as I looked repeatedly at other rootlets, similarly treated, and could never discover these elastic threads, I infer that the branch had probably been slightly moved from the wall at some critical period, whilst the fluid secreted from the rootlets was in the act of drying and of changing its nature through the absorption of its watery parts. The genus *Ficus* abounds with caoutchouc, and from the facts here given we may infer that this substance, at first in solution and ultimately modified into an unelastic cement, is used by *Ficus repens* to cement its rootlets to any object which it may ascend. Whether most other plants, which climb by their rootlets, emit any cement I do not know; but the rootlets of the Ivy, placed against glass, barely adhered to it, yet secreted a little yellowish matter. I may add, that the rootlets of *Marcgravia dubia* can adhere firmly to smooth painted wood.

Vanilla aromatica emits aërial roots a foot in length, which point straight down to the ground. According to Mohl (S. 49), these crawl into crevices, and, when they meet with a thin support, wind round it, like tendrils. A plant which I kept was young, and did not form long roots; but on placing thin sticks in contact with them, they certainly bent, in the course of about a day, a little to that side, and adhered by their rootlets to the wood; but they did not bend quite round the sticks, and afterwards they repursued their downward course. If these rootlets are really sensitive to contact and bend to the touched side, in this case the class of root-climbers blends into that of tendril-bearers. According to Mohl, the rootlets of certain species of *Lycopodium* likewise act as tendrils.

Concluding Remarks.

Plants become climbers, in order, it may be presumed, to reach the light, and to expose a large surface of leaves to its action and to that of the free air. This is effected by climbers with

wonderfully little expenditure of organized matter, in comparison with trees, which have to support a load of heavy branches by a massive trunk. Hence, no doubt, it arises that there are in all quarters of the world so many climbing plants belonging to so many different orders. These plants have been here classed under three heads:—Firstly, hook-climbers, which are, at least in our temperate countries, the least efficient of all, and can climb only in the midst of an entangled mass of vegetation. Secondly, root-climbers, which are excellently adapted to ascend naked faces of rock: when they climb trees, they are compelled to keep much in the shade; they cannot pass from branch to branch, and thus cover the whole summit of a tree, for their rootlets can adhere only by long-continued and close contact with a steady surface. Thirdly, the great class of spiral-twiners, with the subordinate divisions of leaf-climbers and tendril-bearers, which together far exceed in number and in perfection of mechanism the climbers of the two previous classes. These plants, by their power of spontaneously revolving and of grasping objects with which they come in contact, can easily pass from branch to branch, and securely ramble over a wide and sun-lit surface.

I have ranked twiners, leaf- and tendril-climbers as subdivisions of one class, because they graduate into each other, and because nearly all have the same remarkable power of spontaneously revolving. Does this gradation, it may be asked, indicate that plants belonging to one subdivision have passed, during the lapse of ages, or can pass, from one state to the other; has, for instance, a tendril-bearing plant assumed its present structure without having previously existed as either a leaf-climber or a twiner? If we consider leaf-climbers alone, the idea that they were primordially twiners is forcibly suggested. The internodes of all, without exception, revolve in exactly the same manner as twiners; and some few can still twine well, and many others in a more or less imperfect manner. Several leaf-climbing genera are closely allied to other genera which are simple twiners. It should be observed, that the possession by a plant of leaves with their petioles or tips sensitive, and with the consequent power of clasping any object, would be of very little use, unless associated with revolving internodes, by which the leaves could be brought into contact with surrounding objects. On the other hand, revolving internodes, without other aid, suffice to give the power of climbing; so that, unless we suppose that leaf-climbers simultaneously acquired both capacities, it seems probable that they were at first twiners, and

subsequently became capable of grasping a support, which, as we shall presently see, is a great additional advantage.

From analogous reasons, it is probable that tendril-bearing plants were primordially twiners, that is, are the descendants of plants having this power and habit. For the internodes of the majority revolve, like those of twining plants; and, in a very few, the flexible stem still retains the capacity of spirally twining round an upright stick. With some the internodes have lost even the revolving power. Tendril-bearers have undergone much more modification than leaf-climbers; hence it is not surprising that their supposed primordial revolving and twining habits have been lost or modified more frequently than with leaf-climbers. The three great tendril-bearing families in which this loss has occurred in the most marked manner are the Cucurbitaceæ, Passifloraceæ, and Vitaceæ. In the first the internodes revolve; but I have heard of no twining form, with the exception (according to Palm, S. 29. 52) of *Momordica balsamina*, and this is only an imperfect twiner. In the other two families I can hear of no twiners; and the internodes rarely have the power of revolving, this power being confined to the tendrils; nevertheless the internodes of *Passiflora gracilis* have this power in a perfect manner, and those of the common Vine in an imperfect degree: so that at least a trace of the supposed primordial habit is always retained by some members of the larger tendril-bearing groups.

On the view here given, it may be asked, Why have nearly all the plants in so many aboriginally twining groups been converted into leaf-climbers or tendril-bearers? Of what advantage could this have been to them? Why did they not remain simple twiners? We can see several reasons. It might be an advantage to a plant to acquire a thicker stem, with short internodes bearing many or large leaves; and such stems are ill fitted for twining. Any one who will look during windy weather at twining plants will see that they are easily blown from their support; not so with tendril-bearers or leaf-climbers, for they quickly and firmly grasp their support by a much more efficient kind of movement. In those plants which still twine, but at the same time possess tendrils or sensitive petioles, as some species of *Bignonia*, *Clematis*, and *Tropæolum*, we can readily observe how incomparably more securely they grasp an upright stick than do simple twiners. From possessing the power of movement on contact, tendrils can be made very long and thin; so that little organic matter is expended in their development, and yet a wide circle is swept.

Tendril-bearers can, from their first growth, ascend along the outer branches of any neighbouring bush, and thus always keep in the full light; twiners, on the contrary, are best fitted to ascend bare stems, and generally have to start in the shade. In dense tropical forests, with crowded and bare stems, twining plants would probably succeed better than most kinds of tendril-bearers; but the majority of twiners, at least in our temperate regions, from the nature of their revolving movement, cannot ascend a thick trunk, whereas this can be effected by tendril-bearers, if the trunks carry many branches or twigs; and in some cases they can ascend by special means a trunk without branches, but with rugged bark.

The object of all climbing plants is to reach the light and free air with as little expenditure of organic matter as possible; now, with spirally ascending plants, the stem is much longer than is absolutely necessary; for instance, I measured the stem of a kidney-bean, which had ascended exactly two feet in height, and it was three feet in length: the stem of a pea, ascending by its tendrils, would, on the other hand, have been but little longer than the height gained. That this saving of stem is really an advantage to climbing plants I infer from observing that those that still twine, but are aided by clasping petioles or tendrils, generally make more open spires than those made by simple twiners. Moreover, such plants very generally, as was observed over and over again with the several leaf-climbers, after taking one or two turns in one direction, ascend for a space straight, and then reverse the direction of their spire. By this means they ascend to a considerably greater height, with the same length of stem, than would otherwise be possible; and they can do it with safety, as they secure themselves at intervals by their clasping petioles.

We have seen that tendrils consist of various organs in a modified state, namely, leaves and flower-peduncles, and perhaps branches and stipules. The position alone generally suffices to show when a tendril has been formed from a leaf; and in *Bignonia* the lower leaves are often perfect, whilst the upper ones terminate in a tendril in place of a terminal leaflet; in *Eccremocarpus* I have seen a lateral branch of a tendril replaced by a perfect leaflet; and in *Vicia sativa*, on the other hand, leaflets are sometimes replaced by tendril-branches; and many other such cases could be given. But he who believes in the slow modification of species will not be content simply to ascertain the homological nature of different tendrils; he will wish to learn, as far as possible, by what steps

parts acting as leaves or as flower-peduncles can have wholly changed their function, and have come to serve as prehensile organs.

In the whole group of leaf-climbers abundant evidence has been given that an organ, still subserving its proper function as a leaf, may become sensitive to a touch, and thus grasp an adjoining object. In several leaf-climbers true leaves spontaneously revolve; and their petioles, after clasping a support, grow thicker and stronger. We thus see that true leaves may acquire all the leading and characteristic qualities of tendrils, namely, sensitiveness, spontaneous movement, and subsequent thickening and induration. If their blades or laminæ were to abort, they would form true tendrils. And of this process of abortion we have seen every stage; for in an ordinary tendril, as in that of the Pea, we can discover no trace of its primordial nature; in *Mutisia clematis*, the tendril, in shape and colour, closely resembles a petiole with the denuded midribs of its leaflets; and occasionally vestiges of laminæ are retained or reappear. Lastly, in four genera in the same family of the Fumariaceæ we see the whole gradation; for the terminal leaflets of the leaf-climbing *Fumaria officinalis* are not smaller than the other leaflets; those of the leaf-climbing *Adlumia cirrhosa* are greatly reduced; those of the *Corydalis claviculata* (a plant which may indifferently be called a leaf-climber or tendril-bearer) are either reduced to microscopical dimensions or have their blades quite aborted, so that this plant is in an actual state of transition; and, finally, in the *Dicentra* the tendrils are perfectly characterized. Hence, if we were to see at the same time all the progenitors of the *Dicentra*, we should almost certainly behold a series like that now exhibited by the above-named four genera. In *Tropæolum tricolorum* we have another kind of passage; for the leaves which are first formed on the young plant are entirely destitute of laminæ, and must be called tendrils, whilst the later-formed leaves have well-developed laminæ. In all cases, in the several kinds of leaf-climbers and of tendril-bearers, the acquirement of sensitiveness by the mid-ribs of the leaves apparently stands in the closest relation with the abortion of their laminæ or blades.

On the view here given, leaf-climbers were primordially twiners, and tendril-bearers (of the modified leaf division) were primordially leaf-climbers. Hence leaf-climbers are intermediate in nature between twiners and tendril-bearers, and ought to be related to both. This is the case: thus the several leaf-climbing

species of the *Antirrhineæ*, of *Solanum*, of *Cocculus*, of *Gloriosa* are related to other genera in the same family, or even to other species in the same genus, which are true twiners. On the other hand, the leaf-climbing species of *Clematis* are very closely allied to the tendril-bearing *Naravelia*: the Fumariaceæ include closely allied genera which are leaf-climbers and tendril-bearers. Lastly, one species of *Bignonia* is both a leaf-climber and a tendril-bearer, and other closely allied species are twiners.

Tendrils of the second great division consist of modified flower-peduncles. In this case likewise we have many interesting transitional states. The common Vine (not to mention the *Cardiospermum*) gives us every possible grade from finely developed tendrils to a bunch of flower-buds, bearing the single usual lateral flower-tendril. And when the latter itself bears some flowers, as we know is not rarely the case, and yet retains the power of clasping a support, we see the primordial state of all those tendrils which have been formed by the modification of flower-peduncles.

According to Mohl and others, some tendrils consist of modified branches: I have seen no such case, and therefore of course know nothing of any transitional states, if such occur. But *Lophospermum* at least shows us that such a transition is possible; for its branches spontaneously revolve, and are sensitive to contact. Hence, if the leaves of some of the branches were to abort, they would be converted into true tendrils. Nor is it so improbable as it may at first appear that certain branches alone should become modified, the others remaining unaltered; for we have seen with certain varieties of *Phaseolus* that some of the branches are thin and flexible and twine, whilst other branches on the same plant are stiff and have no such power.

If we inquire how the petiole of a leaf, or the peduncle of a flower, or a branch first becomes sensitive and acquires the power of bending towards the touched side, we get no certain answer. Nevertheless an observation by Hofmeister* well deserves attention, namely, that the shoots and leaves of all plants, whilst young, move after being shaken; and it is almost invariably young petioles and young tendrils, whether formed of modified leaves or flower-peduncles, which move on being touched; so that it would appear as if these plants had utilized and perfected a widely distributed and incipient capacity, which capacity, as far as we can see, is of no service to ordinary plants. If we

* Quoted by F. Cohn, in his remarkable memoir, "Contractile Gewebe im Pflanzenreiche," Abhand. der Schlesichen Gesell. 1861, Heft i. S. 35.

further inquire how the stems, petioles, tendrils, and flower-peduncles of climbing plants first acquired their power of spontaneously revolving, or, to speak more accurately, of successively bending to all points of the compass, we are again silenced, or at most can only remark, that the power of movement, both spontaneous and from various stimuli, is far more common with plants, as we shall presently see, than is generally supposed to be the case by those who have not attended to the subject. There is, however, the one remarkable case of the *Maurandia semperflorens*, in which the young flower-peduncles spontaneously revolve in very small circles, and bend themselves, when gently rubbed, to the touched side; yet this plant certainly profits in no way by these two feebly developed powers. A rigorous examination of other young plants would probably show some slight spontaneous movements in the peduncles and petioles, as well as that sensitiveness to shaking observed by Hofmeister. We see at least in the *Maurandia* a plant which might, by a little augmentation of qualities which it already possesses, come first to grasp a support by its flower-peduncles (as with *Vitis* or *Cardiospermum*) and then, by the abortion of some of its flowers, acquire perfect tendrils.

There is one interesting point which deserves notice. We have seen that some tendrils have originated from modified leaves, and others from modified flower-peduncles; so that some are foliar and others axial in their homological nature. Hence it might have been expected that they would have presented some difference in function. This is not the case. On the contrary, they present the most perfect identity in their several remarkable characteristics. Tendrils of both kinds spontaneously revolve at about the same rate. Both, when touched, bend quickly to the touched side, and afterwards recover themselves and are able to act again. In both the sensitiveness is either confined to one side or extends all round the tendril. They are either attracted or repelled by the light. The latter case is seen in the foliar tendrils of *Bignonia capreolata* and in the axial tendrils of the *Ampelopsis*, both of which move from the light. The tips of the tendrils in these two plants become, after contact, enlarged into disks, which are at first adhesive by the secretion of some cement. Tendrils of both kinds, soon after grasping a support, contract spirally; they then increase greatly in thickness and strength. When we add to these several points of identity the fact of the petiole of the *Solanum jasminoides* assuming the most characteristic feature of the axis, namely, a closed ring of woody vessels, we can hardly

avoid asking, whether the difference between foliar and axial organs can be of so fundamental a nature as is generally supposed to be the case*.

We have attempted to trace some of the stages in the genesis of climbing plants. But, during the endless fluctuations in the conditions of life to which all organic beings have been exposed, it might have been expected that some climbing plants would have lost the habit of climbing. In the cases given of certain South African plants belonging to great twining families, which in certain districts of their native country never twine, but reassume this habit when cultivated in England, we have a case in point. In the leaf-climbing *Clematis flammula*, and in the tendril-bearing Vine, we see no loss in the power of climbing, but only a remnant of that revolving-power which is indispensable to all twiners, and is so common, as well as so advantageous, to most climbers. In *Tecoma radicans*, one of the Bignoniaceæ, we see a last and doubtful trace of the revolving-power.

With respect to the abortion of tendrils, certain cultivated varieties of *Cucurbita pepo* have, according to Naudin†, either quite lost these organs or bear semi-monstrous representatives of them. In my limited experience, I have met with only one instance of their natural suppression, namely, in the common Bean. All the other species of *Vicia*, I believe, bear tendrils; but the Bean is stiff enough to support its own stem, and in this species, at the end of the petiole where a tendril ought to have arisen, a small pointed filament is always present, about a third of an inch in length, and which must be considered as the rudiment of a tendril. This may be the more safely inferred, because I have seen in young unhealthy specimens of true tendril-bearing plants similar rudiments. In the Bean these filaments are variable in shape, as is so frequently the case with all rudimentary organs, being either cylindrical, or foliaceous, or deeply furrowed on the upper surface. It is a rather curious little fact, that many of these filaments when foliaceous have dark-coloured glands on their lower surfaces, like those on the stipules, which secrete a sweet fluid; so that these rudiments have been feebly utilized.

One other analogous case, though hypothetical, is worth giving. Nearly all the species of *Lathyrus* possess tendrils; but *L. nissolia* is destitute of them. This plant has leaves, which must have

* Mr. Herbert Spencer has recently argued ('Principles of Biology,' 1865, p. 37 *et seq.*) with much force that there is no fundamental distinction between foliar and axial organs in plants.

† Annales des Sc. Nat. 4th series, Bot. tom. vi. 1856, p. 31.

struck every one who has noticed them with surprise, for they are quite unlike those of all common papilionaceous plants, and resemble those of a grass. In *L. aphaca* the tendril, which is not highly developed (for it is unbranched, and has no spontaneous revolving-power), replaces the leaves, the latter in function being replaced by the large stipules. Now if we suppose the tendrils of *L. aphaca* to become flattened and foliaceous, like the little rudimentary tendrils of the Bean, and the large stipules, not being any longer wanted, to become at the same time reduced in size, we should have the exact counterpart of *L. nissolia*, and its curious leaves are at once rendered intelligible to us.

It may be added, as it will serve to sum up the foregoing views on the origin of tendril-bearing plants, that if these views be correct, *L. nissolia* must be descended from a primordial spirally-twining plant; that this became a leaf-climber; that first part of the leaf and then the whole leaf became converted into a tendril, with the stipules by compensation greatly increased in size*; that this tendril lost its branches and became simple, then lost its revolving-power (in which state it would resemble the tendril of the existing *L. aphaca*), and afterwards losing its prehensile power and becoming foliaceous would no longer be called a tendril. In this last stage (that of the existing *L. nissolia*) the former tendril would reassume its original function of a leaf, and its lately largely developed stipules, being no longer wanted, would decrease in size. If it be true that species become modified in the course of ages, we may conclude that *L. nissolia* is the result of a long series of changes, in some degree like those just traced.

The most interesting point in the natural history of climbing plants is their diverse powers of movement; and this led me on to their study. The most different organs—the stem, flower-peduncle, petiole, mid-ribs of the leaf or leaflets, and apparently aërial roots—all possess this power.

In the first place, the tendrils place themselves in the proper position for action, standing, for instance in the *Cobæa*, vertically upwards, with their branches divergent and their hooks turned outwards, and with the young terminal shoot thrown on one side; or, as in *Clematis*, the young leaves temporarily curve themselves downwards, so as to serve as grapnels.

* Moquin-Tandon (Eléments de Tératologie, 1841, p. 156) gives the case of a monstrous Bean, in which a case of compensation of this nature was suddenly effected; for the leaves had completely disappeared and the stipules had grown to an enormous size.

Secondly, if the young shoot of a twining plant, or if a tendril, be placed in an inclined position, it soon bends upwards, though completely secluded from the light. The guiding stimulus to this movement is no doubt the attraction of gravity, as Andrew Knight showed to be the case with germinating plants. If a succulent shoot of almost any plant be placed in an inclined position in a glass of water in the dark, the extremity will, in a few hours, bend upwards; and if the position of the shoot be then reversed, the now downward-bent shoot will reverse its curvature; but if the stolon of a Strawberry, which has no tendency to grow upwards, be thus treated, it will curve downwards in the direction of, instead of in opposition to, the force of gravity. As with the Strawberry, so it is generally with the twining shoots of the *Hibbertia dentata*, which climbs laterally from bush to bush; for these shoots, when bent downwards, show little and sometimes no tendency to curve upwards.

Thirdly, climbing plants, like other plants, bend towards the light by a movement closely analogous to that incurvation which causes them to revolve. This similarity in the nature of the movement was well seen when climbing plants were kept in a room, and their first movements in the morning towards the light, and their subsequent revolving movements, were traced on a bell-glass. We have also seen that the movement of a revolving shoot, and in some cases of a tendril, is retarded or accelerated in travelling from or to the light. In a few instances tendrils bend in a conspicuous manner towards the dark. Many authors speak as if the movement of a plant towards the light was as directly the result of the evaporation or of the oxygenation of the sap in the stem, as the elongation of a bar of iron from an increase in its temperature. But, seeing that tendrils are either attracted to or repelled by the light, it is more probable that their movements are only guided and stimulated by its action, in the same manner as they are guided by the force of attraction from or towards the centre of gravity.

Fourthly, we have in stems, petioles, flower-peduncles, and tendrils the spontaneous revolving movement which depends on no outward stimulus, but is contingent on the youth of the part and on its vigorous health, which again of course depends on proper temperature and the other conditions of life. This is perhaps the most interesting of all the movements of climbing plants, because it is continuous. Very many other plants exhibit spontaneous movements, but they generally occur only once during the life of the plant, as in the movements of the stamens and pistils, &c., or at intervals of time, as in the so-called sleep of plants.

Fifthly, we have in the tendrils, whatever their homological nature may be, in the petioles and tips of the leaves of leaf-climbers, in the stem in one case, and apparently in the aërial roots of the *Vanilla*, movements—often rapid movements—from contact with any body. Extremely slight pressure suffices to cause the movement. These several organs, after bending from a touch, become straight again, and again bend when touched.

Sixthly, and lastly, most tendrils, soon after clasping a support, but not after a mere temporary curvature, contract spirally. The stimulus from the act of clasping some object seems to travel slowly down the whole length of the tendril. Many tendrils, moreover, ultimately contract spontaneously even if they have caught no object; but this latter useless movement occurs only after a considerable lapse of time.

We have seen how diversified are the movements of climbing plants. These plants are numerous enough to form a conspicuous feature in the vegetable kingdom; every one has heard that this is the case in tropical forests; but even in the thickets of our temperate regions the number of kinds and of individual plants is considerable, as will be found by counting them. They belong to many and widely different orders. To gain some crude idea of their distribution in the vegetable series, I marked, from the lists given by Mohl and Palm (adding a few myself, and a competent botanist, no doubt, could add many more), all those families in 'Lindley's Vegetable Kingdom' which include plants in any of our several subdivisions of twiners, leaf-climbers, and tendril-bearers; and these (at least, some in each group) all have the power of spontaneously revolving. Lindley divides Phanerogamic plants into fifty-nine Alliances; of these, no less than above half, namely thirty-five, include climbing plants according to the above definition, hook- and root-climbers being excluded. To these a few Cryptogamic plants must be added which climb by revolving. When we reflect on this wide serial distribution of plants having this power, and when we know that in some of the largest, well-defined orders, such as the Compositæ, Rubiaceæ, Scrophulariaceæ, Liliaceæ, &c., two or three genera alone, out of the host of genera in each, have this power, the conclusion is forced on our minds that the capacity of acquiring the revolving-power on which most climbers depend is inherent, though undeveloped, in almost every plant in the vegetable kingdom.

It has often been vaguely asserted that plants are distinguished from animals by not having the power of movement. It should rather

be said that plants acquire and display this power only when it is of some advantage to them; but that this is of comparatively rare occurrence, as they are affixed to the ground, and food is brought to them by the wind and rain. We see how high in the scale of organization a plant may rise, when we look at one of the more perfect tendril-bearers. It first places its tendrils ready for action, as a polypus places its tentacula. If the tendril be displaced, it is acted on by the force of gravity and rights itself. It is acted on by the light, and bends towards or from it, or disregards it, whichever may be most advantageous. During several days the tendril or internodes, or both, spontaneously revolve with a steady motion. The tendril strikes some object, and quickly curls round and firmly grasps it. In the course of some hours it contracts into a spire, dragging up the stem, and forming an excellent spring. All movements now cease. By growth the tissues soon become wonderfully strong and durable. The tendril has done its work, and done it in an admirable manner.

Letters from Sir H. Barkly and Swinburne Ward, Esq., relative to the Coco de Mer.

[Read Nov. 3, 1864.]

Government House, Mauritius, June 6, 1864.

Sir,—Having brought the resolution adopted by the Linnean Society, on 3rd of March, relative to the destruction of the Sea Cocoa-nut Tree in the Seychelles Islands, under the notice of the Civil Commissioner of that group, and called upon him to suggest officially what measures could be taken to ensure the preservation of the remaining trees, I have received the report of which I now beg to enclose a copy.

The Society will be glad to learn that Mr. Ward did not find, on a visit of inspection, that that destruction had been carried so far as had been represented to him, but that, on the contrary, one forest of these Palms in Ile Praslin is carefully preserved by its owner, and still contains magnificent specimens.

As this island is almost entirely private property, the interference of the Government would be difficult, except in the way of exhortation and remonstrance; but as Ile Curieuse, where a certain number of trees are found, is still vested in the Crown, and used for a purpose which renders it inaccessible to the public,

I trust there can be no danger under any circumstances of the extinction of this most interesting species.

I am confident that whilst Mr. Ward remains in his present post he will do all in his power to protect the existing trees, and to secure the planting of others.

I remain, Sir,
Your obedient Servant,
HENRY BARKLY.

To George Bentham, Esq.,
President L.S., &c., &c.

Preservation of the Coco de Mer.

Civil Commissioner's Office, Seychelles, May 17, 1864.

SIR,—I have the honour to acknowledge the receipt of your letter (No. H. 890) of May 6th enclosing a communication from the Linnean Society on the subject of the destruction of Coco de Mer trees at Praslin, and directing me to report, for the information of his Excellency the Governor, upon the measures which ought to be taken for the preservation of such of the Lodoicea trees as now remain,

2. The paper on the Coco de Mer, to which the Linnean Society alludes, was written a short time after my arrival; but although I had made a tour of inspection round the islands, including Praslin and Curieuse, I had not then visited the district in which this Palm principally flourishes.

3. There is no doubt that the Coco de Mer has entirely disappeared from many parts of the Island of Praslin, where it formerly abounded—destroyed by accidental conflagrations, and ruthlessly cut down to make room for manioc cultivation. The land in these parts of Praslin, with a very small exception, is entirely in the hands of private individuals, and no steps could have been taken by Government with respect to preserving the trees.

4. I returned, on the 9th instant, from a visit to the more distant islands of the group in the 'Pleiad,' which was placed at my disposal by Colonel Playfair, and I took the opportunity, during this tour, of visiting the Lodoicea-forest at Ause Marie Louise, on the southern point of the Island of Praslin—a small lovely valley reaching to the sea-board, surrounded by lofty hills, the sides and crests of which are covered with Lodoicea several hundred in number.

5. This forest is the property of a Mr. Campbell; and I am glad to be able to report that more care is taken of the trees here than is the case in any other part of the island. They may be seen in all stages of growth, from the sharp, sword-shaped spattie just shooting from the ground, to palms one hundred and twenty feet in height, long since arrived at maturity, and at whose age it is impossible even to guess. None are actually planted by the proprietor; but he occasionally allows nuts to remain and take root where they fall; and as the trees are usually surrounded at the base by thick undergrowth, many other nuts are overlooked by the men employed to collect them, a certain amount of reproduction being thus ensured.

6. The leaves of the male trees alone are cut for the sake of the material from which hats, fans, and baskets are made. Cutting these leaves prevents the trees from giving any blossom; but the male trees preponderate over the female, and those growing in almost inaccessible spots, which flower undisturbed, are quite sufficient to fecundate all the female trees in the district. The flowering process continues for years; and the small blossoms that spring from the huge catkin forming the basis, as it were, of the flowers, are reproduced, apparently, *ad infinitum*.

7. A comparatively small number of trees are found on Curieuse Island, and these never attain the same size and perfection as those at Praslin. Soon after my arrival, I gave directions to Mr. Forbes, in charge of the lesser establishment, to keep up the supply by planting germinating nuts; but he succeeded with but a small proportion of those planted. Unfortunately, too, several trees which were thriving in the vicinity of the cemetery were accidentally burnt. I have directed him to plant all the germinating nuts that he can find for the future, and to take all the care he can of the trees now remaining.

8. When at Praslin, I selected a Coco de Mer with a perfect healthy germ nearly a foot in length, which I forwarded to Sir William Hooker, by the 'Noma,' on the 11th instant.

I have the honour to be, Sir,

Your most obedient Servant,

(Signed) SWINBURNE WARD,

Civil Commissioner.

To the Honourable the Colonial Secretary, &c.

Notes on *Pueraria*, DC., correctly referred by the author to *Phaseoleæ*. By George Bentham, P.L.S.

[Read Feb. 16, 1865.]

DeCandolle first published the genus *Pueraria* in the 'Annales des Sciences Naturelles,' iv. p. 97, and in his 'Mémoires sur les Légumineuses,' p. 252, for the *Hedysarum tuberosum*, Roxb., which has the habit and foliage of the large twining Phaseoleæ, besides differing from *Hedysarum* in the inarticulate pod, which, however, he did not possess quite ripe. With this he associated a second, Nepalese species, which had certainly a flat 2-valved Phaseoleous pod. Wight and Arnott (Prod. Fl. Pen. Ind. Or. p. 205) at first followed De Candolle in including the genus among Clitorieæ, but subsequently some specimens in the Hookerian herbarium induced them to believe the pod to be really articulate; and in the Addenda et Corrigenda, p. 445, they express their fear that the genus must be reduced to *Desmodium*. Presuming that this was correct, and seeing that the articulation of the pod was confirmed by the figure in Wight's 'Icones,' t. 412, I proposed, in the 'Plantæ Junghuhnianæ,' i. p. 231, to reduce *Pueraria* to the single *P. tuberosa*, and to add the other species to a new genus *Neustanthus*, which I there established for the *Dolichos phaseoloides*, Roxb., and some allied species. Having now, however, many specimens of *P. tuberosa* with the pod nearly ripe, showing no signs of articulation, I turned to the specimens which had misled Arnott, and find that the supposed articulation is only a contraction between the seeds where an ovule has failed, which appears to be frequently the case; and as to Wight's figure, I find that in the original drawing from which it was taken, the deceptive transverse lines indicating the joints do not exist; they must have been added by Dr. Wight's artist with a view to correcting the drawing to suit the written character. It follows, therefore, that my genus *Neustanthus* must now be merged in *Pueraria*, slightly modifying the character I gave in the 'Plantæ Junghuhnianæ' and in the 'Flora Hongkongensis,' so as to include the flat-podded species. The genus thus established has the habit and pod of *Phaseolus* or of some allied genera, with the flowers more like those of *Dioclea*. It comprises nine species, differing often considerably from each other in the calyx, the form of the petals, or in the degree of adherence of the upper stamen, as well as in the pod, but all, I

believe, most conveniently considered as congeners. The following is a short synopsis of their characters.

PUERARIA, *DC.*

Calycis lobi v. dentes 2 superiores in unum integrum v. bifidum connati. *Vexillum* obovato-orbiculatum, auriculis inflexis sæpissime appendiculatum; *alæ* falcatæ carinæ medio plus minus adhærentes; *carina* rectiuscula v. apice incurva v. rostrata, alis paullo brevior v. sublongior. *Filamentum* vexillare ima basi liberum medio cum cæteris connatum v. rarius omnino solutum. *Antheræ* uniformes. *Ovarium* subsessile, ∞-ovulatum; *stylus* superne incurvus, filiformis, imberbis, stigmate parvo capitato. *Legumen* lineare, rectum v. rarius apice incurvum, planum v. demum subteres, 2-valve, intus inter semina nudum farctum v. septatum. *Semina* parva, estrophiolata, hilo brevi.—*Herbæ* suffruticesve alte volubiles. *Folia* pinnatim 3-foliolata, foliolis latis integris v. sinuato-trilobis, stipellatis. *Stipulæ* herbaceæ v. striatæ. *Flores* in pedunculis elongatis axillaribus v. ad apices ramorum subpaniculatis fasciculato-racemosi, fasciculorum rhachi nodiformi v. rarius in ramulum evoluta. *Bracteæ* angustæ v. parvæ caducissimæ; *bracteolæ* parvæ interdum diutius persistentes.

Species omnes Asiaticæ. Genus a *Dioclea* differt legumine et sæpius calyce, a *Galactia* nunc calyce nunc staminibus et semper habitu, a *Phaseolo* affinibusque carina et stylo.

* *Stipulæ peltatim affixæ (infra insertionem productæ). Calycis laciniæ tubo longiores. Legumen planum latiusculum.*

1. P. THOMSONI, *Benth.* sp. n. Calycis lobis acuminatis tubo multo longioribus, vexillo suborbiculato, alis carina obtuse rostrata subbrevioribus, legumine plano latiusculo membranaceo pilis longis rufis hirsutissimo.

Rami alte volubiles pilis longis patentibus plus minus hirsuti. *Foliola* late rhombea v. lateralia late et oblique ovata, breviter et acute acuminata, integra v. late sinuato-triloba, sæpe 4–5 poll. diametro. *Stipulæ* herbaceæ semipollicares et longiores, paullo infra medium affixæ; *stipellæ* setaceæ, longiusculæ. *Pedunculi* elongati, supra medium floriferi. *Bracteæ* lineari-subulatæ, longe ante anthesin deciduæ; *bracteolæ* breves, ovatæ, striatæ. *Pedicelli* ad nodos crassiusculos plures, per anthesin 1 lin., demum 2 lin. longi, reflexi. *Calyx* fere 6 lin. longus. *Vexillum* 8–9 lin. longum, basi auriculis inflexis appendiculatum; *carina* vexillum subæquans. *Filamentum* vexillare ima basi brevissime solutum. *Legumen* rectum, usque ad 4 poll. longum ½ poll. latum. *Semina* suborbiculato-compressa.

Hab. Khasia, *J. D. Hooker and Thomson.*

2. P. THUNBERGIANA. Calycis lobis tubo longioribus, vexillo obovato,

alis carinam incurvo-dilatatam obtusissime subrostratam æquantibus, legumine plano latiusculo membranaceo pilis longis rufis hirsutissimo. —Pachyrrhizus Thunbergianus, *Sieb. et Zucc. Fam. Nat. Fl. Jap.* ii. 113; Neustanthus Chinensis, *Benth. Fl. Hongk.* 86.

Habitus folia et inflorescentia fere *P. Thomsoni*, sed minus villosa. *Radix* (v. rhizoma?) tuberosa. *Foliola* in speciminibus omnia integra glabriuscula v. subtus pilis adpressis conspersa. *Stipulæ* lanceolatæ, peltatæ; *stipellæ* setaceæ longiusculæ. *Calycis* tubus 1 lin. longus; lobi lanceolati, supremus latus et infimus angustior 2–2½ lin. longi, laterales paullo minores. *Vexillum* 7–8 lin. longum, reflexum, biauriculatum et supra unguem intus leviter 2-callosum; alæ carina multo angustiores, basi inæqualiter biauriculatæ; carina 6–7 lin. longa. *Filamentum* vexillare ima tantum basi brevissime solutum. *Legumen* omnino *P. Thomsoni* nisi sæpius incurvum. *Semina P. Thomsoni.*

Hab. Japan, *Sieb.*; Nagasaki and Simoda, *Oldham*; Hongkong, *Harland*,

The style and fruit are quite different from those of *Pachyrrhizus*, to which genus Zuccarini had referred it from a similarity of habit and foliage and, in many respects, of flowers.

** *Stipulæ basi non productæ. Calycis dentes v. lobi breves v. tubo æquilongi. Legumen planum latiusculum.*

3. P. TUBEROSA, *DC. Prodr.* ii. 240. Calycis tomentoso-villosi lobis tubo brevioribus, vexillo suborbiculato reflexo biappendiculato, alis falcato-obovatis carinam late incurvam obtusam æquantibus, filamento vexillari subsoluto, legumine plano latiusculo pilis longis rufis hirsuto. —Hedysarum tuberosum, *Roxb. Fl. Ind.* iii. 363; Pueraria tuberosa, *Wight, Ic.* t. 412 (quoad legumen falsa).

Caulis e radice (v. rhizomate?) tuberosa altissime volubilis per anthesin sæpius aphylli. *Indumentum* breve molle sæpe tomentosum imprimis in inflorescentia. *Foliola* ampla (½–1-pedalia ex Roxb.) rhomboidea v. lateralia oblique ovata. *Stipulæ* ovatæ subcordatæ; *stipellæ* subulatæ. *Pedunculi* rigiduli, ad nodos superiores defoliatos subfasciculati v. paniculati. *Pedicelli* brevissimi, sæpius terni, rhachi fasciculorum minuta nodiformi. *Bracteæ* ovato-lanceolatæ, caducissimæ; *bracteolæ* parvæ ovatæ subpersistentes. *Calyx* 2–3 lin. longus mollis, lobis obtusis v. infimo acuto, vix dimidia tubi longitudine. *Vexillum* circiter 5 lin. longum, lateribus reflexis, basi auriculis inflexis appendiculatum. *Legumen* 2–3 poll. longum, 3–4 lin. latum, inter semina sæpe constrictum.

Hab. Hill forests throughout E. India.

4. P. CANDOLLEI, *Grah. in Wall. Cat. Herb. Ind.* n. 5353. Calycis glabriusculi lobis acutis tubo paullo longioribus, vexillo orbiculato biappendiculato, alis late falcatis carinam subincurvam obtusam superantibus, filamento vexillari medio cum cæteris connato, legumine plano latiusculo glabro v. vix puberulo.

Caulis altissimus ut videtur more *P. tuberosæ* per anthesin aphyllus. *Foliola* ampla stipulæ et stipellæ *P. tuberosæ*. *Pedunculi* longissimi, fere a basi floridi, ad nodos defoliatos paniculati, apice bracteis linearibus breviter comosi. *Nodi floriferi* vix conspicui, pedicellis subsolitariis v. fasciculatis 1–2 lin. longis. *Calyx* 3½ lin. longus, lobis lanceolatis; *bracteolæ* parvæ. *Vexillum* 6 lin. longum, lateribus reflexis. *Carina* alis non latior. *Legumen* fere *P. Wallichii*, sed nonnisi immaturum vidi.

Hab. Pegu, *Wallich, Lobb, Maclellan.*

5. P. PEDUNCULARIS, *Grah. in Wall. Cat. Herb. Ind.* n. 5354. Calycis glabriusculi laciniis tubo brevioribus, vexillo obovato anguste biauriculato, alis carinam apice inflexo-dilatatam erostrem subsuperantibus, filamento vexillari soluto, legumine plano latiusculo glaberrimo.—Neustanthus peduncularis, *Benth. in Pl. Jungh.* i. 255.

Herba alte volubilis, villosa. *Foliola* ampla, integra, acuminata, uti stipulæ et stipellæ, iis *P. Wallichii* similia. *Pedunculi* elongati, tenues. *Pedicelli* graciles, fasciculorum rhachi parva nodiformi. *Calyx* latus, tenuis, 2½ lin. longus, lobo supremo latissimo 2-dentato, inferioribus acutiusculis tubo paullo brevioribus. *Petala* fere 7 lin. longa, in sicco pallida, carina apice intensius colorata. *Vexillum* basi angustatum, ecallosum. *Filamentum* vexillare latiusculum et vaginæ cæterum arcte appressum, at non adhærere videtur. *Legumen* rectum, nitidulum, 2, rarius 3 poll. longum, 3 lin. latum, valvis submembranaceis.

Hab. Nepal, *Wallich*; Khasia and Sikkim, *J. D. Hooker and T. Thomson.*

6. P. WALLICHII, *DC. Prodr.* ii. 240, et *Mem. Leg.* t. 43. Calycis glabriusculi truncati dentibus brevissimis latis, vexillo obovato vix auriculato, alis carina leviter incurva subbrevioribus, filamento vexillari cum cæteris connato, legumine plano latiusculo glabro subcoriaceo.

Alte volubilis, tenuiter pubescens v. glabrescens. *Foliola* ampla, obliqua, acuminata, integra. *Stipulæ* lanceolatæ, caducissimæ; *stipellæ* minutæ, setaceæ. *Pedunculi* elongati, graciles. *Pedicelli* graciles, fasciculorum rhachi in forma normali parva subnodiformi. *Calyx* vix 2 lin. longus, membranaceus, dentibus nunc obsoletis nunc brevissimis latis, infimo paullo eminentiore. *Vexillum* ¾ poll. longum, basi in unguem brevem angustatum, exauriculatum v. auriculis angustissimis inflexis subappendiculatum. *Carina* vexillum æquans. *Filamentum* vexillare ima basi brevissime solutum, cæterum per anthesin cum cæteris in tubum clausum connatum. *Legumen* rectum, 3–5 poll. longum, 3–6 lin. latum.

Hab. Nepal, Khasia, Assam, Burma.

Var. *composita*, florum fasciculorum rhachi in ramulum brevem excurrente.—P. composita, *Grah. in Wall. Cat. Herb. Ind.* n. 5570.

Hab. With the normal form.

*** *Stipulæ infra insertionem non productæ. Calycis laciniæ tubo longiores v. paullo breviores. Legumen angustum (1½–2 lin. latum) compressum v. subteres, intus sæpius septatum.*

7. P. PHASEOLOIDES. Calycis pilosi dente infimo setaceo-acuminato tubo longiore cæteris brevioribus, alis carinam breviter rostratam superantibus, legumine angusto subtereti piloso.—Dolichos phaseoloides, *Roxb. Fl. Ind.* iii. 316; D. viridis, *Ham. in Wall. Cat. Herb. Ind.* n. 5559; Phaseolus decurrens, *Grah. in Wall. l. c.* n. 5612; Neustanthus phaseoloides, *Benth. in Pl. Jungh.* i. 234.

Tota pilis rufescentibus v. in pagina inferiore foliolorum subcanescentibus plus minus vestita. *Foliola* ovato-rhombea, integra v. sæpe triloba, subtus dense sericeo-villosa. *Stipulæ* ovato-lanceolatæ, striatæ. *Stipellæ* longiuscule setaceæ. *Pedunculi* subsemipedales, supra medium interrupte floridi, fasciculorum rhachi nodiformi. *Flores* vix 4 lin. longi. *Calyx* 2 lin. longus, lobo v. dente summo triangulari 2-dentato, lateralibus parvis, infimo multo longiore. *Legumen* 2, v. interdum 3 poll. longum, 1½ lin. latum, intus inter semina septatum. *Semina* parva, transverse oblonga, hilo laterali.

Hab. Common in Northern and Eastern India, Malacca, and S. China.

8. P. JAVANICA. Calycis puberuli dentibus obtusis omnibus tubo brevioribus, alis carinam arcuato-subrostratam subæquantibus, legumine angusto subtereti piloso.—Neustanthus Javanicus, *Benth. in Pl. Jungh.* i. 235; *Miq. Fl. Ind. Bat.* i. pars i. 218. t. 4.

P. phaseoloidi affinis, sed omnibus partibus major. *Caulis* pilis longis hirsutus v. fere glaber. *Foliola* integra v. triloba, subtus pilis adpressis nunc raris nunc densis vestita. *Indumentum* inflorescentiæ breve subsericeum. *Flores* quam in *P. phaseoloide* multo majores. *Calyx* 3 lin. longus, petala 7–8 lin. longa.

Hab. Java, *Zollinger, Junghuhn, Horsfield,* and others.

Neustanthus sericans (Miq. Fl. Ind. Bat. i. part 1. 218) appears to be a slight variety, with very few or none of the long spreading hairs of the common one.

9. P. SUBSPICATA. Calycis lobis setaceo-acuminatis tubo longioribus, alis carina arcuato-rostrata brevioribus, legumine angusto compresso piloso.—Dolichos spicatus, *Wall. Cat. Herb. Ind.* n. 5557; Neustanthus subspicatus, *Benth. in Pl. Jungh.* i. 234.

Habitus et folia *P. Javanicæ*. *Racemi* superne densiflori, fasciculis multifloris, rhachi nodiformi. *Bracteæ* lato-lanceolatæ caducæ; *bracteolæ* ovato-lanceolatæ, striatæ, subpersistentes. *Pedicelli* 1–2 lin. longi. *Calyces* rufo-pilosi, 4–6 lin. longi. *Vexillum* et *carina* ¾-poll. *Legumen* 3–5 poll. longum, vix 2 lin. latum, subplanum.

Hab. Assam and Khasia.

Note of Observations and Experiments on Germination.

By G. Dickie, M.D., F.L.S.

[Read February 16, 1865.]

The supposed persistence of cotyledons in *Welwitschia*, and the established fact that in *Streptocarpus* one of them remains during the whole lifetime of the plant, assuming the appearance of a leaf, are points in vegetable physiology which need not be enlarged upon here.

Having carefully traced the germination of *Streptocarpus Rexii* and *S. primuloides*, I observed a peculiarity which seems to have been overlooked in the only paper on this subject which I have seen, viz. the interesting communication of Mr. Crocker in the 5th volume of the Linnean Society's Journal.

The two cotyledons are at first opposite and equal in size; in one instance I have seen three; after some time, however, they become alternate, the space between the two varying somewhat in different seedlings. At a more advanced stage, the upper cotyledon thus separated from its fellows begins to enlarge, the other retaining its original size, and afterwards decaying.

On first observing this separation of the cotyledons, I was of opinion that it was owing to the development of an internode. There might be another explanation, namely this, that the one cotyledon remaining sessile, the development of a petiole at the base of the other would give rise to this alternation, which according to one view would be real, and to the other only apparent. I am inclined, however, to believe that there is true alternation consequent on the development of an internode. This has relation to a point respecting which there has been of late some discussion*, viz. the nature of the descending axis, and which internode is to be counted as the first.

In connexion with this, it occurred to me that it might be possible, by a certain kind of treatment, to lengthen the existence of cotyledons in plants in which they are usually of comparatively short duration. For this purpose it seemed advisable to experiment on plants having large cotyledons which rise above ground, become green like leaves, and for some time perform a similar function: I proceeded to put this to the test.

* See a recent Number of Nat. Hist. Review and of Silliman's Journal.

About the middle of the summer of 1864, having beside me a few seedlings of the castor-oil plant, I pinched off the plumule in several; subsequent attempts at the formation of a new axis and leaves required the operation to be repeated, after which the cotyledons alone remained and increased to nearly double the ordinary dimensions, the axis which supported them growing also in length and diameter. The plants so treated continued to live for three months, and would doubtless have survived longer; but, owing to neglect, they were injured by attacks of insects, and after some time decayed; the result, however, was so far satisfactory, since the life of the cotyledons was extended far beyond the existence of these organs in plants left to run the ordinary course.

The next experiment, towards the end of July 1864, was made on a species of *Ipomœa*: the large foliaceous cotyledons I considered as rather an advantage for my purpose. The plumule in one plant was pinched, and, as in the former case, the operation required to be repeated; another individual was left uninjured, for the sake of comparison, and at the end of three months it had produced abundance of leaves, with shoots of 12 to 18 inches in length, and a few flower-buds, which, owing to want of sufficient light, dropped off, as did the cotyledons, about the end of two weeks after germination. The other plant which had been pinched continued to live for more than three months, the cotyledons remaining fresh and green and attaining a larger size than under ordinary conditions. Owing to the unfavourable period of the year, these cotyledons began, at the end of the time mentioned, to assume an unhealthy appearance, and, as the phrase is, they ultimately "damped off." The axis of the mutilated plant made quite as rapid progress as that of the other below the scars of the cotyledons, and at the end of the experiment the two were about equal in diameter.

It is my intention to commence a new set of experiments, and, of course, under more favourable conditions as regards the period of the year.

There are certain obvious precautions necessary in this matter, such as careful inspection of cotyledons in order to prevent injury from insects or mould, and due moderation in supplies of fluid where the evaporating surface is so limited; further, great care is requisite in handling the cotyledons.

On *Musa Livingstoniana*, a new Banana from Tropical Africa.

By JOHN KIRK, M.D., F.L.S.

[Read January 19, 1865.]

Musa Livingstoniana, sp. nov.

Hab. The mountains of Equatorial Africa. Gorongozo, south latitude 19°; Manganja, south latitude 14°; Maravi country, south latitude 12°, and the Niger region?

In habit this Banana is undistinguishable from *Musa Ensete*, Gmel. Syst., and Hook. Journ. Bot. and Bot. Mag. vol. lxxxvii. tab. 5. 223, 224 (*M. Ensete*, Bruce), which is also a native of the same region.

Where found, several grew together, and the natives had built huts under their shade. Possibly it is cultivated in some parts.

It is 18 feet high; the stem thick, conical, and bulged at the base, where it is of a purple colour.

The leaf is nearly sessile, the midrib thick, and the blade broad. In these respects it resembles *M. Ensete*; but the seed is very different. All we know of the fruit is from fallen and withered specimens. There is a pendent group of many leathery capsules, each 4 inches long, with several seeds; these are the size of a pea, 5″ long, 4″ broad, tuberculated on the surface, rounded, with flattened facets: at one extremity is a deep hilum with raised prominent edges; at the other a disk-shaped elevation.

The testa is black, but not glossy as in *M. Ensete*, hard and brittle. The albumen is white and mealy, deeply convex at both ends, where the hilum and the disk-shaped elevation project inwards.

The natives ascribe virtues to these seeds, as fetish; and wear them in the purification of women. The seeds of *M. Ensete* are used in a similar way, but for another purpose.

I find in the Museum of the Royal Gardens, Kew, seeds sent from the Niger Expedition by Mr. Barter, undistinguishable from those brought home by myself.

The common Banana (*M. sapientum*) is grown in the country, but has been introduced, as its distribution shows.

On the Diatomaceæ of Otago, New Zealand.

By W. Lauder Lindsay, M.D., F.R.S. Edinb., &c.

[Read February 16, 1865.]

I should not deem the following brief list of Otago Diatoms worthy of separate presentation or publication were it not that, insignificant as it is, it forms, so far as I am aware, the first contribution that has yet been offered to our knowledge of the Diatomaceæ of our New Zealand possessions.

The list contains only 110 species*, 30 genera and 12 families, and includes only 3 new species, viz. *Cymbella Lindsayana* Grev., *Stauroneis scaphulæformis* Grev., and *S. rotundata* Grev. Considering the newness of the field of research, the comparative paucity of new forms (2·72 per cent. of the whole) may appear incommensurate and extreme†; but this scantiness will become at least less surprising when we bear in mind Berkeley's prediction, that foreign Diatoms will be found to exhibit "*few new species, and certainly no novel forms*"‡. However, quite as interesting as the discovery of new species and the multiplication of names, is addition to, or improvement of, our knowledge of the geographical range of the lower and more minute forms of vegetation. Even so meagre a list as that which follows does not fail to add to the number of cosmopolites—of British forms occurring in very distant lands, or of species otherwise widely or peculiarly distributed.

Without affixing any value to generalizations based on data so defective, it may yet be here set forth, as among the results of analysis of the following list, that—

I. The dominant *families* are—	No. of Genera.	No. of Species.
1. Naviculeæ	5	38
2. Surirelleæ	5	21

II. The dominant *genera* are—	
1. Navicula	15
2. Pinnularia	12
3. Gomphonema	9
4. { Stauroneis	8
{ Synedra	8
5. Surirella	7
6. Epithemia	6
7. Cymbella	5

* *Excluding varieties.*

† There are *no* new *genera* or *families.*

‡ Introduction to Cryptogamic Botany, p. 128. London, 1857.

III. The proportion of species to a genus is 3·66.

IV. The proportion of species to a family 9·16.

My collection of Diatomaceæ was made towards the close of 1861, in the Greenisland district of Otago, around the station or farm of Fairfield*, Saddlehill, which formed my head quarters for three months. The special habitats or localities were—

I. The lagoons and marshes of the Kaikorai stream, between Abbott's Creek Bridge and the sea. These were low and stagnant after a track of dry weather.

The substances or media in which the Diatoms were contained were chiefly—

a. Mud, from their edges or bottom.

b. Scum, including Confervaceous and other vegetation from their surface.

II. Ditches on roadsides in various parts of Greenisland, especially on the Great South (or Invercargill) Road,—the medium being, for the most part, mud from their shady sides.

III. Damp ravines, caves, or faces of rock, generally shaded by foliage. These included waterfalls, and rock-surfaces over which water constantly trickled, or which were more or less covered or coated by a mass of Algæ, Hepaticæ, or Mosses always soaked in moisture.

a. (1.) Woodburn ravine, seaward slope of Saddlehill.
(2.) Various ravines among the Chain Hills.

b. Limestone-caves near Woodburn.

c. Faces of rock at—

1. Coal-pit, Abbott's Creek.
2. Abbott's Creek Bridge.
3. Behind Greenisland Church.
4. In the bush†, Greenisland.

The Diatoms were generally contained in the slime or vegetation scraped from the rock-surfaces.

It will thus be seen that the collection was made from a most limited area. It does not pretend to offer a fair representation of the Diatoms, even of Dunedin, the capital of Otago; far less can it be regarded as typical of Otago or New-Zealand Diatoms in

* About seven miles southward of Dunedin, on the Great Southland Road.

† Colonial or local name for the primitive forest.

general. It was confined, further, to *freshwater* species; and it was made altogether under circumstances unfavourable to the arrangement of a typical series, or of the gathering new or interesting forms*.

Considering the frequency with which *fossil* Diatoms occur, and are found identical with, or closely allied to, existing species, I anticipated the discovery of not a few interesting forms in the Newer Tertiary Marine Limestones (or Calcareous Sandstones) of the Greenisland district of Otago, which abound in minute Foraminifera; but Professor Rupert Jones, of Sandhurst, who has kindly examined† the series of these rocks I collected in 1861, reports the non-discovery, as yet, of any Diatoms. Still I think they will be found, though the interest attaching to their discovery can scarcely be complete till we are in a position to compare with them the existing Diatoms of the sea-bottom of the New Zealand coasts.

Fam. I. EUNOTIEÆ‡.

Genus 1. Epithemia.

1. E. gibba, *Ehr.*
2. E. musculus, *K.*
3. E. Westermanniæ, *Ehr.*
4. E. zebra, *Ehr.*
5. E. turgida, *Ehr.*
6. E. sorex, *K.*

Genus 2. Eunotia.

1. E. gracilis, *Sm.*

Genus 3. Himantidium.

1. H. pectinale, *K.*
2. H. bidens, *Ehr.*

Fam. II. MERIDIEÆ.

Genus 1. Meridion.

1. M. circulare, *Grev.*
2. M. constrictum, *Ralfs.*

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* It may interest local collectors to learn that one-half of the muds, &c., which I collected in the hope of their containing Diatoms, were found to contain them.

† Specially, however, for *Foraminifera.*

‡ I am indebted for the determination of the species, as well as for the arrangement, in the following list, to the kindness of Dr. Greville, of Edinburgh, the first living British authority in that no less intricate than interesting special department of botanical research which relates to the Diatomaceæ. He is describing and figuring the new species in the Trans. Bot. Soc. Edinb.

Fam. III. FRAGILARIEÆ.

Genus 1. Denticula.

1. D. tenuis, *K.*

Genus 2. Odontidium.

1. O. mutabile, *Sm.*

Genus 3. Fragilaria.

1. F. capucina, *Desm.*

Genus 4. Nitzschia.

1. N. parvula, *Sm.?*
2. N. amphioxys, *Ehr.*
3. N. minutissima, *Sm.*
4. N. spathulata, *Bréb.*

Fam. IV. SURIRELLEÆ.

Genus 1. Homœocladia.

1. H. sigmoidea, *Sm.*

Genus 2. Synedra.

1. S. minutissima, *K.*
2. S. radians, *K.*
3. S. tenuis, *K.*
4. S. delicatissima, *Sm.*
5. S. tenera, *Sm.*
6. S. Ulva, *Ehr.*
   — ——, var. β, *Sm.*
7. S. acuta, *Ehr.*
8. S. fasciculata, *Ag.*

Genus 3. Tryblionella.

1. T. gracilis, *Sm.*
2. T. debilis, *Ryland, MS.*
3. T. angustata, *Sm.*
4. T. levidensis, *Sm.*

Genus 4. Surirella.

1. S. biseriata, *Bréb.*
2. S. linearis, *Sm.*
3. S. splendida, *Ehr.*
4. S. tenera, *Greg.*
5. S. ovata, *K.*
6. S. minuta, *Bréb.*
7. S. elegans.

Genus 5. Campylodiscus.

1. C. cribrosus, *Sm.*

Fam. V. STRIATELLEÆ.

Genus 1. Diatomella.

1. D. Balfouriana, *Grev.*

Fam. VI. MELOSIREÆ.

Genus 1. Cyclosella.

1. C. operculata, *K.*
2. C. Kützingiana, *Thw.*?
3. C. punctata, *Sm.*
4. C. minutula.

Genus 2. Hyalodiscus.

1. H. subtilis, *Bail.*

Genus 3. Melosira.

1. M. subflexilis, *K.*
2. M. varians, *Ag.*
3. M. orichalcea, *Mert.*

Fam. VII. COSCINODISCEÆ.

Genus 1. Actinoptychus.

1. A. undulatus, *K.*

Fam. VIII. COCCONEIDEÆ.

Genus 1. Cocconeis.

1. C. pediculus, *Ehr.*
2. C. placentula, *Ehr.*

Fam. IX. ACHNANTHEÆ.

Genus 1. Achnanthidium.

1. A. lanceolatum, *Bréb.*
2. A. lineare, *Sm.*
3. A. coarctatum, *Breb.*
4. A. trinode, *Arn.*

Genus 2. Achnanthes.

1. A. exilis, *K.*

Fam. X. CYMBELLEÆ.

Genus 1. Cymbella.

1. C. cuspidata, *K.*
2. C. apiculata.
*3. C. Lindsayana, *Grev. MS.*, nov. sp.
4. C. obtusiuscula, *K.*
5. C. Helactica, *K.*

Genus 2. Cocconema.

1. C. lanceolatum, *Ehr.*

Genus 3. Amphora.

1. A. ovalis, *K.*

Fam. XI. GOMPHONEMEÆ.

Genus 1. Gomphonema.

1. G. constrictum, *Ehr.*
2. G. curvatum, *K.*
3. G. cristatum, *Rab.*
4. G. augur, *Ehr.*
5. G. tenellum, *K.*
6. G. intricatum, *K.*
7. G. vibrio, *Ehr.*
8. G. dichotomum, *K.*
9. G. æquale, *Greg.*

Fam. XII. NAVICULEÆ.

Genus 1. Navicula.

1. N. lævissima, *K.*
2. N. cocconeiformis, *Greg.*
3. N. claviculus, *Greg.*
4. N. elliptica, *K.*
5. N. inflata, *K.*
6. N. pusilla, *Sm.*
7. N. crassinervia, *Bréb.*
8. N. cryptocephala, *K.*
9. N. affinis, *Ehr.*
10. N. rhomboides, *Ehr.*
11. N. lanceolata, *Ag.*
12. N. cuspidata, *K.*, var. craticula.
    [Surirella craticula, *auct.*]
13. N. scita, *Sm.*
14. N. firma, *K.*
15. N. tumida, *Bréb.*

Genus 2. Pinnularia.

1. P. major, *Sm.*
2. P. viridis, *Sm.*
3. P. acuminata, *Sm.*
4. P. peregrina, *Ehr.*
5. P. radiosa, *Sm.*
6. P. viridula, *Sm.*
7. P. stauroneiformis, *Sm.*
8. P. gibba, *Ehr.*
9. P. mesolepta, *Ehr.*
10. P. interrupta, *Sm.*
11. P. subcapitata, *Greg.*
12. P. borealis, *Ehr.*

Genus 3. Stauroneis.

1. S. constricta, *Ehr.*
2. S. anceps, *Ehr.*
3. S. linearis, *Ehr.*
4. S. platystoma, *Ehr.*
5. S. Phœnicerteron, *Nitz.*
6. S. gracilis, *Ehr.*

*7. S. scaphulæformis, *Grev. MS.*, nov. sp.

*8. S. rotundata, *Grev. MS.*, nov. sp.

Genus 4. Mastogloia.

1. M. lanceolata, *Thw.*

Genus 5. Colletonema.

1. C. vulgare, *Thw.*
2. C. neglectum?, *Thw.*

Notes on the Chatham Islands (lat. 44° 30′ S., long. 175° W.). By Henry Hammersley Travers, Esq. In a letter to his Father, W. T. L. Travers, Esq., F.L.S. Communicated by Mr. Travers.

[Read Nov. 3, 1864.]

Christchurch, May 18, 1864.

My dear Father,—In accordance with your instructions, I proceeded to the Chatham Islands group by a schooner (the 'Cecilia,' of 40 tons) which sailed from Lyttelton on the 12th of October last. Our voyage was slow and somewhat uninteresting, and it was not until the 19th that we sighted the Horns, two conical-shaped hills, on the south-western extremity of Chatham Island. On the way down we met large numbers of Right Whales, Hump-backs, and Porpoises, and were, as usual, accompanied by Albatroses and Cape Pigeons. After sighting the main island, we proceeded directly to Pitt's Island, and came to anchor off a rocky point, forming the western extremity of a small bay, at the north end of the island, and at the head of which is the residence of Mr. Frederick Hunt, an Englishman who had been settled there for nearly twenty years. Opposite Mr. Hunt's house is a rock called the "Flower-pot," which forms a shelter for boats engaged in landing or shipping goods. The house is close to the beach, and is surrounded by about 250 acres of cleared land, mostly laid down to English grasses, and divided into paddocks, forming a very compact and well-cultivated farm. With the exception of these clearings, and of insignificant patches of open land in various parts of the island, the whole of Pitt's Island is covered with bush.

I was received with great civility by Mr. Hunt and his family, who invited me to stay with them during the time I should be engaged in collecting plants, &c. On this occasion, however, I remained on Pitt's Island for a week only, having been detained by a tremendous gale from the north-west. We left on the 24th, and reached Waitangi, a Maori settlement on Chatham Island, on the following day. Here I presented my letters to Captain Thomas, the Collector of Customs, by whom I was treated most courteously, and who promised to give me every assistance in his power, in carrying out the objects of my journey.

Waitangi is the chief Maori settlement on Chatham Island, and is situated at the south-eastern extremity of Petre Bay, which forms an indentation, some 17 or 18 miles deep, on the south-

western side of the island. But for this bay, the shape of the island would have been nearly that of an isosceles triangle, of which the south-western side would have formed the base. A small but deep river flows into the bay close to Waitangi, washing, on its western side, the foot of some low ridges composed of basaltic and doleritic tufas. This river drains a considerable tract of hilly ground on the south side of the bay, and is also fed by a stream running from a lagoon at the head of the bay. Were it not for a bar at its mouth, vessels of from forty to fifty tons burthen might enter it, as, inside the bar, the water is deep for a considerable distance inland. The huts of the Maories, and the residence of Captain Thomas, are situated on low ground on the east side of the river. The Maori huts are built of fern-posts lashed together with strips of supplejack, and thatched with Toi grass, resembling, in all respects, those found in the old pahs in New Zealand. Captain Thomas's residence is built in the same way, but is plastered inside and out with clay, and whitewashed, and the roof is shingled. A chapel belonging to the Church of England natives is a very handsome specimen of their style of building. The inside walls are lined with fronds of tree ferns, from which the pinnules have been stripped, and which are interwoven, in a curious manner, with leaves of *Phormium tenax*. The roof is braced with boards having white scrolls painted on a red ground. The outside walls and roof are closely and smoothly thatched with Toi grass. The building is about 50 feet long, and nearly 30 feet broad, and about the same height to the top of the roof. There is a smaller building used as a church by the Roman Catholic natives, built in the same style, but more highly decorated and more neatly kept. The population of Waitangi, including a few More-ore slaves, numbers about 150, all told. Their huts are surrounded by well-fenced paddocks, laid down to English grasses; but the grass is now almost smothered with the common English daisy, mustard, and dock, which are spreading rapidly over the whole island. The Maories, generally, possess considerable numbers of horses, cattle, and pigs, which run in common on the open lands and in the bush. They cultivate large quantities of potatoes, maize, pumpkins, and onions, which they supply to American whaling-ships resorting to the islands, and occasionally export to New Zealand. I did not find that they cultivated any European fruits; but they use largely that of a small species of nightshade, indigenous to New Zealand, which they introduced to the Chathams. There are also Maori settlements at Tubong, on the

north-western side of the island, and at Ware-kawri Tuapeka and Kaingaroa, on the north side, having altogether a population of some 400 souls, all told.

The remnant of the More-ores (the name given to the aboriginal inhabitants), exclusive of the few who are still retained in slavery, is settled at Ohangi, on the south-eastern side of the island. They do not exceed 200 in number, and are said to be rapidly decreasing. I believe this to be the case; for during my six months' stay not less than eight deaths occurred amongst them. In their habits of living they now assimilate to the Maories, and speak a language compounded of their own original language and of that of the New Zealanders. Before the invasion of the islands by the New Zealanders, which took place about the year 1832 or 1835, the More-ores were very numerous, numbering little short of 1500 people. They are much shorter, but stouter-built than the New Zealanders, and have darker skins, but the same straight coarse hair; their faces are rounder and more pleasing in expression; their noses are Roman in shape, resembling those of the Jews. They never tattooed; and, although they originally practised cannibalism, they had discontinued it before the arrival of the New Zealanders. They appear to have been a very cheerful people, fond of singing and of telling laughable stories. Their habits of living, however, were originally very rude and improvident. They built no huts, merely using a few branches of trees, stuck into the ground, as a shelter from the wind. Their chief food consisted of fish, birds, shell-fish, and fern-root, which latter they prepared in the same manner as the New Zealanders; but the women always ate apart from the men. Like many other savage tribes, they were very indolent, seldom seeking food until pressed by hunger. They had no canoes, there being no timber on the islands sufficiently large for constructing them; but they formed rafts of the flower-stalks of the *Phormium tenax*, lashed together with supplejack, and having an upright wooden stem, ingeniously carved. The paddles were shaped like a spade, and were used at the stern of the rafts, very much in the same manner as a spade would be used in digging. They made stone axes, similar to those of the New Zealanders; and these, with clubs, &c., constructed from the harder woods growing on the islands, formed their weapons. In their own quarrels, it was understood that the first blood drawn terminated the battle. Such fights were uncommon, and were generally for the possession of a seal's carcass or of some mass of whale-blubber which happened to be

cast ashore, both of which were esteemed choice delicacies. They had no hereditary chiefs, the most successful fisherman or bird-catcher, or any member of the tribe distinguished by extraordinary stature or for any useful physical quality, being looked upon as an authorized leader. They had no idea of a God, in our sense of the term, nor, so far as I could learn, of evil spirits; but they looked upon a good fishing- or birding-ground as being the gift or rather under the charge of an "Atua" or good spirit. Their mode of disposing of their dead had special reference to the particular vocation or fancy of the living subjects. If the dead person had been a good fisherman, for example, his body was lashed, in a sitting posture, to a raft, and sent adrift with a baited line in its hand. If he had been a noted bird-catcher, he was fixed in a stooping position between two trees, facing the particular hill or other spot which he usually frequented. If he had no particular vocation, he was put, in a sitting posture, into an open hole in the ground, usually about 18 inches deep, with any favourite piece of carved wood stuck up before him. Mr. Alexander Shand, son of the late Collector of Customs at Waitangi, is, I believe, well acquainted with their traditions and customs, and will, no doubt, be able to give you full information upon the various subjects to which I have thus shortly referred. So far as I could learn, the chronology of the More-ores, unlike that of the New Zealanders, is very defective; and consequently they are unable to fix, even proximately, the date of their first arrival in the islands. They say, however, that they came in two canoes, one of which drifted to sea again, but that the other was preserved for a considerable period. They are quite in the dark as to where they came from originally; but as they resemble the Mangaia Kanakas (who form a large proportion of the crews of the American whaling-vessels), I conceive it is not improbable that they have the same origin.

The islands were invaded in 1832 or 1835 by the New Zealanders, by whom large numbers of the aborigines were killed and eaten. In fact, the expedition of the former may be said to have been undertaken solely for the latter purpose, a Maori, who happened to have visited the islands whilst engaged as a seaman, in a vessel trading from Sydney, having reported the aborigines as a plump, well-fed race, who would fall easy victims to the prowess of his countrymen. By a refinement of cannibal cruelty, the unfortunate wretches were compelled to carry the wood, and prepare the ovens in which they were to be cooked. Such of

them as were destined for the nonce to be eaten were then laid in a row upon the ground adjoining the ovens, and were killed by blows from a Mëre by one of the Maori chiefs. It is not more than twenty years since the Maories gave up these feasts. Although I found the remains of numerous More-ore skeletons in the woods in Pitt's Island, I was unable to get one in good condition. I have, however, brought over several authentic skulls, which will probably be interesting for ethnological purposes.

As I had determined to make Pitt's Island my head quarters, in consequence of its offering greater advantages as a collecting-ground, I took the opportunity of my first visit to Chatham Island to travel round it. Accordingly on Tuesday, the 27th of October, accompanied by Mr. Hunt (who had come over with me from Pitt's Island), I started for the Red Bluff, about six or seven miles north of Waitangi. The road led partly through a belt of bush, which, for a depth of two or three miles, forms a fringe round a large portion of the island, and partly along the sea-shore. The weather, unfortunately, was extremely wet, as, indeed, it was during the whole of my stay on Chatham Island. The bush consisted principally of *Eurybias*, *Coprosmas*, *Karaka*, *Dracophyllum*, *Solanum*, &c., with several tree ferns (amongst which I noticed large numbers of *Cyathea dealbata*), the whole so interwoven with our old friend the Supplejack, as to be almost impenetrable. Amongst the ferns I found a *Lomaria* closely allied to, if not identical with, *Lomaria discolor*, *Phymatodes Billardieri* and *pustulata*, and several others, common in the bush in New Zealand. On the beach the *Myosotidium nobile* grew with rank luxuriance wherever it had not been invaded by the pigs, which feed eagerly upon the roots. The Maories dry the leaves, and smoke them as a substitute for tobacco. Where the sea-shore was sandy, I noticed a coarse sand-grass, identical with one of those which occurs upon the Dunes near Christchurch.

From the Red Bluff we proceeded to Wangaroa, on the north side of Petre Bay, and thence, leaving a large tract of sand-hills between that place and Tubong on our left, we crossed to Wari-kauri on the north side of the island. This route led us past several small lagoons, apparently destitute of water-plants, but fringed partly with rushes and partly with bush similar to that before described. The country here is low, and is now covered with a young growth of grasses and sedges, mixed with *Pteris esculenta*, and with here and there occasional patches of *Phormium tenax*.

On the sandy tract before alluded to (between Wangaroa and Tubong) I noticed large quantities of a small but beautiful shrub, apparently belonging to the genus *Leucopogon*, growing amongst the fern and sand-grass above referred to. From Wari-kauri we proceeded to Taupeka, once a large Maori settlement, but now containing only a few huts. Here we slept, and on the next day went to Kaingaroa, travelling along a sandy beach, fringed with bush, into which we occasionally passed in order to avoid rocky points projecting into the sea. With the exception of Eurybias, I found no plants in flower; and indeed the weather was so extremely wet, that I gave up all idea of collecting at that time. We remained at Kaingaroa for three or four days, one of which I spent at the residence of Mr. Shand at Wakuru, by whose family I was hospitably entertained. From Kaingoroa we went to Okawa or Waikiri, formerly the principal Maori settlement, and the chief scene of their cannibal festivities, and thence returned to the Red Bluff, passing over the Great Lagoon along a reef of highly crystalline limestone, which lies about a foot below the surface of the water, and crosses it from east to west. This reef is generally from forty to fifty yards broad, but occasionally narrows to fourteen or fifteen yards, and has throughout a sloping bank on each side.

The lagoon is nearly twenty miles in length from north to south, and from eight to nine broad at the north end, narrowing to three or four at its southern extremity. It almost intersects the island, the space between the north bank and the sea-shore being little more than two miles broad, whilst at the south-eastern end it is only separated from the sea by a sand-bank 100 or 150 yards in width. This bank is periodically broken through by the accumulated waters of the lagoon, the breach, after the lagoon has sunk to high-water mark, being repaired by the wash of the sea from the south-east. The lagoon is in some places bordered by extensive spongy tracts of *Jungermannia*, in others by grasses, sedges, and rushes, and in others again by bush, similar to that which occurs on the sea-shore. I did not find any water-plants, such as *Potamogeton*, &c., in any of the lagoons, though in the centre of a small lagoon on the north side of the island I observed some vegetable substances spread upon the surface of the water; in consequence, however, of the depth of the water, and of their distance from the edge of the lagoon, I was unable to obtain any specimens.

The general surface of Chatham Island, except of that part

which lies to the south of Petre Bay, is low and slightly undulating, with occasional hills. For example, on the tract to the north of the bay (to the left of the route from Wangaroa to Wari-kauri) there are three or four conical hills, attaining an elevation of 600 or 700 feet, and composed of basaltic and doleritic rocks, and some lower hills near the sea-coast on the north side of the island. These hills are clothed with bush from top to bottom. The country to the eastward of the Great Lagoon is very low, scarcely rising in any part more than 50 feet above the sea-level. The peninsula to the south of Petre Bay is more hilly; the hills composed principally of basalts and tufas, and presenting, from Jenny Reef round to Cape Fournier, abrupt escarpments to the sea. The soil is peaty, and is often 50 feet deep. In several parts of the island this peat has been on fire for years, burning at a considerable depth below the surface, which, when sufficiently undermined, caves in, and is consumed. I have seen the loose ashes arising from these fires upwards of 30 feet deep. In one place I noticed, in the burning peat, at the depth of 6 or 7 feet from the surface of the ground, the trunks of trees of a growth evidently far exceeding any that are now to be found on the islands. I was, I am sorry to say, unable to obtain any specimens, in consequence of the great height of the wall of peat and the mass of hot ashes below. The surface-growth (exclusive of bush) consists principally of grasses and sedges, with patches of fern; but I have little doubt that large numbers of indigenous herbaceous plants have been destroyed, partly by the constant firing of the surface by the natives, and partly by the pigs, cattle, and horses which roam all over it. Nearly the whole country had, in fact, been burnt shortly before my arrival.

There are at present but few land-birds either on this or on Pitt's Island. Formerly the White Crane (*Herodias flavirostris*), the Bittern (*Botaurus melanotus*), an Apteryx, said by the Maories to have been identical with a New Zealand species, and also, according to their accounts, a smaller species of the same bird (though I believe this to be the *Rallus Dieffenbachii*), the Weka (*Ocydromus australis*), and the Kakapo (*Strigops habroptilus*) were found on both islands, but have become extinct since their invasion by the New Zealanders. Mr. Hunt informed me that the last time he had seen the Bittern was about three years ago. The land-birds now found are a large Falcon, the Pigeon, the Tui or Parson-bird, the Pukeko (*Porphyrio melanotus*), the Parrakeet (*Platycercus*, N. Z.), the Fantail, the Pihoihoi or Lark,

and a small Titmouse, all identical with birds of the same species found in New Zealand. I was told by Mr. Hunt that the Pigeon was first seen on the islands within the last eight years, and that the Titmouse appeared shortly after the occurrence of the great fire in Australia, known as the "Black Thursday fire." Mr. Hunt is a very careful and trustworthy person; and as his statement relative to the Pigeon was confirmed by the Maories, I have full reason for believing what he told me, in regard to both birds, to be true. Of aquatic birds, I saw the Grey Duck, Brown Teal, and two species of Shag common in New Zealand, and a large number of Gulls and other sea-birds similar to those which frequent the coasts of that country. Mutton-birds were extraordinarily numerous on a rock known as the Fort, lying between Chatham and Pitt's Islands. During my journey round Chatham Island, of which I have given you an account above, I saw a peculiar Teal on one of the lagoons near the Red Bluff. This bird had bright scarlet markings on the wings. I fired at it; but, owing to the great dampness of the weather, the gun I had with me hung fire, and I missed the bird. I never saw another specimen, and was informed that it was very uncommon. The number of land-birds of all kinds, however, is extremely limited; indeed it is rare to meet with any at all during a whole day's walk in the bush. I attribute their destruction principally to wild cats, the progeny of imported animals, although I was informed that a species of Gull or Sea-Hawk also attacks the land-birds, and is especially destructive to poultry.

Besides wild cats, which are common on both islands, there are on Chatham Island swarms of the Norway Rat and English Mouse. I believe there were no indigenous terrestrial mammals on either island, not even a bat; but seals, of several kinds, and whales and porpoises are abundant on the coasts, the former frequenting reefs at some distance from the shore.

I left Chatham Island about the 25th of November, and proceeded to Pitt's Island, where I took up my residence with Mr. Hunt. As I have before mentioned, the whole of Pitt's Island, with a very trifling exception, is covered with bush. In my first rambles in the bush, both here and on Chatham Island, I was struck with the perfect identity of the great majority of the plants with those of New Zealand; but, as you will observe from the collections I made, I felt it my duty to take even those about which I had no doubt whatsoever.

In connexion with the remarkable similarity of the flora gene-

rally to that of New Zealand, I may mention that in a small tract of bush on the margin of the Great Lagoon I found three trees of the *Edwardsia microphylla*, all growing close together, and being the only specimens of that plant that I saw on either island. They were not in flower or fruit at the time. They were apparently all of equal age, and were about 5 inches in diameter and 15 feet high. Mr. Hunt, to whom I pointed them out, stated that he had never seen the plant before. During my residence at Pitt's Island, I was in the habit of examining the coast of the bay on which Mr. Hunt's house is situated twice a day for some months; and on one occasion I found a sawn plank of *Totara*, and on another a seed of the same *Edwardsia*, which had evidently been washed ashore, probably from New Zealand. The seed was hard and sound. I gave it to Mr. Hunt, who sowed it; but there has been, as yet, no time to learn the result. I also saw, on the beach, logs of white and red Pines (*Podocarpus excelsus* and *Dacrydium mai*) and *Totara*, which had been washed ashore some time previously. This would indicate the existence of currents direct from New Zealand to this place, probably favoured by the set from Cook's Straits during heavy north-westerly gales.

There is but one hill on Pitt's Island, which does not exceed 600 feet in height. It is composed of basaltic or doleritic rock, is perfectly flat-topped, the summit having an area of about eighty acres covered with peat to the depth of 5 or 6 feet, and supporting a mixed growth of grass, fern, *Phormium tenax*, and shrubs. From the summit of this hill a good view of the whole group of islands is obtained. I was, unfortunately, unable to visit South-east Island, which appears to be the highest land in the group, and which I was told contained several plants not to be found either on Chatham or Pitt's Islands. I had one opportunity of visiting it; but, owing to the great dampness of the season, I was afraid to leave my collections, which required unremitting attention. During one short absence, I lost a very large number of plants (including my only specimens of *Euphorbia*, *Edwardsia microphylla*, and *Mesembryanthemum*), which, on my return, I found to be one mass of mildew. The several members of Mr. Hunt's family were, during the whole time of my stay, so busily employed in their various duties that I felt I could not impose upon them the extra task of attending to the plants; and this prevented me from visiting the various outposts and reefs connected with the Chatham Islands group.

In regard to insects, &c., my knowledge is too limited for me

to venture upon many observations respecting those which occur on the islands. I noticed, however, amongst others, the common New Zealand blue-bottle and yellow flesh flies, and the European or Australian house-fly; mosquitoes and sandflies are abundant. In the bush I saw a considerable number of spiders, including one very large *Mygale*, which also frequented buildings, making its nest in the thatch. I found several beetles. Moths and butterflies were rare, the few I met with being apparently identical with New Zealand species.

Several introduced plants are spreading rapidly—for example, the White Clover, the English Daisy, the Dock, the Mustard, the English Burr (which grows with the utmost rankness in the bush on Pitt's Island, often to the height of 3 feet and upwards), the *Polygonum* found on the Canterbury Plains, the wild Strawberry, and others. Indeed, from the luxuriance and rapidity with which these plants grow, I have little doubt that, if not checked, they would soon overcome and replace the indigenous herbaceous vegetation. All kinds of introduced vegetables grow with great vigour; and since the importation of bees, European fruit-trees and bushes have produced freely.

In conclusion I would suggest that if any other person should be tempted to visit the islands for botanizing purposes, the months from December to April inclusive would be found to be the best season.

Your affectionate Son,

HENRY HAMMERSLEY TRAVERS.

On the Lentibularieæ collected in Angola by Dr. WELWITSCH, A.L.S., with an Enumeration of the African Species. By Professor OLIVER, Keeper of the Herbarium and Library, Kew.

[Read December 15, 1864.]

THROUGH the courtesy of Dr. Welwitsch, I have had the opportunity of examining his remarkably fine set of this singular little Order, and of drawing up the following synopsis of all the species collected by him, with descriptions of those which appear to be new. I have added some notes and descriptions of other African Utricularias in the Kew, Dublin, and Linnean Society's herbaria. Altogether ten new species of *Utricularia* and one of *Genlisea* are

described. The occurrence of the latter genus in Africa is interesting, as it has hitherto been regarded as exclusively Brazilian. Specimens of probably the same species as that gathered by Dr. Welwitsch are in the Hookerian and Dublin collections, from Burke (Magaliesberg), and in Mr. Bentham's herbarium, from Zeyher.

It is very difficult to trace the geographical distribution of Bladderworts, owing to the imperfect way in which they are often dried by collectors, and especially to the insufficiency of the published descriptions of many species of which we have not the type specimens within reach. A few of Dr. Welwitsch's plants, if I have correctly determined them, are widely spread. *U. subulata*, of which Barter also gathered specimens in Lagos Island, is a well-known American species: it is the only African *Utricularia* that I have seen with medio-fixed bracts. *U. reticulata*, *U. stellaris*, and *U. diantha* are Indian, as is also *U. cærulea*, of which Barter sent home specimens from the Niger Expedition. Dr. Hooker, in his memoir upon the botany of the Cameroons (Linn. Journ., Bot., vii. 209), records the occurrence upon those mountains, at an elevation of 5000 feet, of the elegant little Indian *U. orbiculata*. It is not in Dr. Welwitsch's herbarium, but it is probably found at Sierra Leone, as pointed out by Benjamin, who indicated its close relationship to, if not identity with, *U. striatula*, Smith, the type specimens of which species are very imperfect. *U. Sandersoni*, described below from specimens (collected at Natal) in the Dublin herbarium, approaches in general *facies* to the group to which *U. orbiculata* and a few Himalayan species belong, but it wants the appendaged seeds which seem to characterize that section of the genus.

1. Genlisea, *St. Hilaire*.

G. africana, sp. nov. Scapo 3–∞-floro, pedicello flori æquilongo vel longiore, corollæ purpureæ labio superiore late ovato, inferiore trilobo calcar porrectum obtusum æquante.—*Folia* carnosula dense rosulata, spathulata v. obovata, obtusa, integerrima, in petiolum angustata, glabra, sæpius ½–1 poll. longa, 1½–4 lin. lata, interdum minuta, v. elongata ad 2 poll. attenuata. *Scapi* 4–14 poll. longi, erecti, interdum ramosi, ramis strictis adscendentibus, squamis 1–4 minutis basifixis remotis sæpe instructi, imo glabri, sursum glanduloso-puberuli vel glabrescentes, raro 1–2-flori. *Bracteæ* minutæ basifixæ lanceolatæ; bracteolæ æquilongæ angustiores. *Pedicelli* graciles, sæpius glanduloso-pubescentes, 3–8 lin. longi, fructiferi adscendentes v. subpatentes. *Calyx* 5-partitus, lobis subæqualibus, oblongo-lanceolatis acutiusculis.

Corolla labio superiore apice rotundato-obtuso v. retuso calycis lobum sup. 2–3-plo superante, labio corollæ inferiore lobis subæqualibus v. centrali majore, calcari crasso sparse glanduloso labio inferiore interdum paulo breviore. *Stigma* 1-labiatum. *Capsula* dehiscentia (interdum irregulariter) circumscissa. *Semina* minuta, plus minus ovoidea, alveolata.

"Flores dilute purpurei, exsicc. cærulescentes."—*Welwitsch.*

Welwitsch, Iter Angolense, no. 260. Distr. Huilla, "in pratis palustribus et campis uliginosis juxta Rivi de Lopollo, socialis cum *Eriocauloneis, Lobeliis, Burmanniæ* specie, etc., ad 5000–5200 ped. alt." Jan. et Feb. 1860! Magaliesberg, *Burke in herb. Hook.*! S. Africa, *Zeyher*, 1425, *in herb. Benth.*!

2. Utricularia, *Linn.*

§ 1. *Scapus ex axi demerso, segmentis multisectis plus minus capillaceis sæpissime utriculiferis, per florescentiam persistente.*

A. *Scapus vesicis inflatis in verticillum unicum dispositis instructus.*

1. U. stellaris, *L.*

Widely spread in Africa, as in India. Dr. Welwitsch sends it from Angola, Mr. Barter from the Niger, and Dr. Kirk from the Zambesi. It has been previously recorded from northern and eastern tropical Africa and also from the Cape.

B. *Scapus nudus vel squamis minutis paucis instructus. Bracteæ solitariæ* (i. e. *bracteolæ* 0).

2. U. reflexa, sp. nov. Scapo 2–1 (rar. 3)-floro, pedicellis elongatis primum floriferis erectis, fructiferis arcte recurvis, corollæ flavæ labio superiore calyce 2–3-plo longiore rotundato integro, labio inferiore amplo calcar porrectum crassum cylindricum obtusum excedente.—*Scapi* erecti, nudi, 2–5 poll. longi. *Bractea* ovato-rotundata, obtusa, amplexicaulis. *Pedicelli* elongati, fructiferi reflexi 1–2 poll. longi. *Calyx* lobis subæqualibus, rotundato-ovatis. "Flores intense flavi" (*Welwitsch*). Ab apice corollæ labii sup. ad extremum calc. labii inferioris circiter 6–8 lin.

Welwitsch, Iter Angolense, no. 269. Distr. Huilla, "Frequens in flum. Guipumpunhime aliisque rivis lente fluentibus territorii Humpatensis, circiter 4800 ped. alt." Apr. 1860! Ufern von Nebenflussen der Schuri, *Vogel in herb. Hook.*! Nupe and confluence of Niger and Quorra, *Barter in herb. Hook.*!

It differs from *Utricularia vulgaris* in bearing only one or two flowers, in the long erect flowering pedicel far overtopping the unexpanded flowers, and in the sharply recurved pedicel of the fruit.

3. U. sp. nov.? aff. U. GIBBÆ, *L.* Scapo 2–1-floro, pedicellis calycem æquantibus v. eodem 2–3-plo longioribus, fructiferis divaricatis, corollæ labio superiore lobo calycis 2–3-plo majore late rotundato, labio inferiore obscure 3-lobulato calcari conico sursum curvulo obtuso æquilongo.—*Scapus* 1–3-unc., sæpius 1–2-florus, firmulus, nudus. *Bractea* basifixa, late rotundata, amplexicaulis. *Calyx* lobis rotundatis obtusis. "Flores aurantiaco-flavi" (*Welwitsch*). Corolla circa 5 lin. longa.

Welwitsch, Iter Angolense, no. 270. Distr. Huilla, "ad ripas . . . . . . lacus magni dicti 'Lagôa de Trantala,' ad circiter 4000 ped. alt."

I have not seen this plant in ripe fruit. It is likely to prove an undescribed species.

4. U. DIANTHA, *Rœm. et Sch.* (U. ambigua, *A. DC. Prod.* viii. 9; U. gracilis, *Lepr. M.S. ined.* For further synonymy, *vide* Journ. Linn. Soc. iii. 176).

Welwitsch, Iter Angolense, no. 267, "frequens (sed hoc unico loco observata) in lacu dicto 'Lagôa da Funda' non procul a flumine Bengo," Sept. 1854! Lagos Island, *Barter in herb. Hook.*! Magaliesberg, *herb. Hook.*! Natal, 5000–6000 feet, *Sutherland in herb. Hook.*!

A species widely distributed in India.

5. U. DIPLOGLOSSA, *Welwitsch, MS.* Scapo unifloro, fructifero recurvo, corollæ labio superiore 2–3-crenato, palato labii inferioris inflato emarginato ad labium superius adpresso, calcari late conico obtuso. —*Scapus* erectus, brevis, 3–9 lin. longus, medio bractea amplexicauli late rotundata truncata instructus, ex axi demerso parce ramoso utriculas atro-virides v. lividas crebros majusculos brevissime pedicellatos gerente. *Corolla* flava labio superiore apice 2–3-crenato (nec bifido), labio inferiore deflexo superiore latiore, margine subintegro, palato maximo, calcari labio inferiori ut videtur subæquali. *Capsula* calycem vix aut paululo superante. *Semina* compressa peltata polygona aptera. "Corolla flava; vesiculæ plerumque livido-purpureæ" (*Welwitsch*). Labium corollæ inferius ad 3 lin. latum.

Welwitsch, Iter Angolense, no. 271. Distr. Huilla, "in spongiosis . . . in editioribus de Morro de Lopolla, ad 3300 ped. alt."

Most of the particulars in this description are taken from Dr. Welwitsch's accurate memoranda. The peculiarities of the flower in such a case can be satisfactorily observed only in living specimens. The species is a singular one, and, so far as I can make out, undescribed.

6. U. CYMBANTHA, sp. nova. Tenuissima, scapo brevissimo (3–6 lin. longo) unifloro, labio superiore corollæ brevissimo retuso lateribus antice productis labio inferiori transversim rotundato-oblongo integro basi cymbiformi-saccato connatis.—*Axis* demersus tenuissimus ramosus, foliis simplicibus vel 2–3-partitis capillaribus utriculiferis. *Scapus* gracillimus. *Bractea* minuta basifixa rotundata obtusa.

Calyx lobis membranaceis subæqualibus rotundatis. *Corolla* parvula labio superiore calycem paulo superante. *Flores* circiter 2 lin. longi, "pallide flavescentes sive straminei" (*Welwitsch*).

Welwitsch, Iter Angolense, no. 272. Distr. Huilla, "nunc natans nunc fere terrestris in stagnis . . . . . . in editioribus sylvaticis de Morro de Lopolla."

This is one of the most remarkable species of the genus that I have seen. The divisions of the submerged leafy axis are almost of microscopic tenuity. The curious form of the flower, owing to the connation of the margins of the very short, but broad retuse upper lip with the scoop-shaped lower lip, the cavity of which is not produced anteriorly in the form of a spur as in most *Utricularias*, but, on the other hand, thins out in this direction, being deepest towards the base of the corolla, distinguishes the plant at once from all other floating species with which I am acquainted. Unfortunately I have not seen mature capsules.

C. *Bracteolæ laterales geminatæ minutissimæ adsunt. Corolla labio inferiore bifido.*

7. U. RIGIDA, *Benj.*

A very remarkable species growing in Senegambia and Sierra Leone, described by Benjamin in the 'Linnæa' (vol. xx. p. 303) from fruiting specimens with imperfect flowers. Having recently seen good specimens in flower in the Dublin and Paris herbaria, I add a description of the corolla and calyx-lobes. Some of the firm and rigid many-flowered scapes are attached to a widely-spreading, much divided, leafy axis with capillary segments, nearly or quite destitute of "bladders;" other scapes are free, but may have been torn off when collected. Whether this leafy axis be submerged or terrestrial I cannot tell: it is probably sometimes one, sometimes the other. In habit the plant resembles the curious Abyssinian genus *Quartinia*, Rich.

Calyx lobis inæqualibus, superiore majore late orbiculato, inferiore ovato-rotundato obtuso. *Corolla* labio superiore calyce duplo longiore ovato-rotundato obtuso integro, labio inferiore bilobo, lobis obtusis, basi ecalcarato leviter saccato.

§ 2. *Scapus basi foliis linearibus, spathulatis v. obovato-spathulatis integris, ante florescentiam sæpe evanescentibus. Semina exappendiculata.*

A. *Bracteæ medio affixæ; bracteolæ* 0. *Flores lutei.*

8. U. SUBULATA, *L.*

Welwitsch, Iter Angolense, No. 257. Distr. Huilla, "in pascuis editis

de Empalanca, locis breve dumetosis muscosis humidiusculis, ad 5000 usque ad 5500 ped. alt.," Apr. 1860! Swamp, Lagos Island, *Barter in herb. Hook.*! (? Sierra Leone, Smeathmann and Afzelius, *herb. Linn. Soc.*).

This is a well-known American plant. Between the African and American specimens I am unable to find any difference. They agree in their setiform scapes and divaricate pedicels, minute bracts free below their insertion, colour of corolla and thick porrect spur, which is about equal in length to the 3-lobed lower lip of the corolla. . . . . .

B. *Scapus squamis, bracteis bracteolisque basifixis.*

a. Pedicelli lobis calycis sæpius longiores v. eisdem subæquilongi.

9. U. RETICULATA, *Smith.*

Welwitsch, Iter Angolense, no. 265. Distr. Huilla, "Valde rara in pratis palustribus subspongiosis ad sinistram fluminis Guipumpunhime Sobati de Humpata (circa 4800 ped. alt.)." Apr. 1860.

Excepting that the pedicels of the young fruits are ascending instead of reflexed, I do not find any difference between this plant and the common Indian typical form. Dr. Welwitsch's specimens are twining, and 14–20 inches tall. What a fine thing this would be to introduce into our tropical aquaria!

10. U. CÆRULEA, *Linn. herb.*; *Oliver in Linn. Proc., Bot.*, iii. 179.

In a swamp in Lagos Island, Niger Expedition, *Barter in herb. Hook.*!

11. U. MANNII, sp. nova. Scapo gracili glabro, 2–5-poll., 1–3-floro, pedicellis sæpius patentibus, corollæ labio superiore erecto suboblongo obtuso integro calycis lobum superiorem obtusum paulo excedente, labio inferiore flabelliformi-cuneato integro, calcari conico-cylindrico recto dependente calycis lobo inferiore longiore, lobo calycis persistentis superiore demum inferiore fere duplo longiore.—*Folia* anguste spathulata obtusa 1–$2\frac{1}{2}$ poll. longa, in petiolum longe angustata. *Scapus* squamis paucis subulatis basifixis instructus. *Calyx* lobo inferiore ovato-elliptico obtuso, demum minute bifido.

Camaroons mountain, 4000–6000 feet, *Mann*!

This is the unnamed plant referred to in Dr. Hooker's memoir on the plants of the Camaroons (Linn. Journ. vii. 209). Specimens in flower have been received since. The colour of the flower remains uncertain.

12. U. SPIRALIS, *Smith* (*A. DC. Prod.* viii. 14).

Sierra Leone, *Afzelius*, 1798.

The solitary specimen in Smith's herbarium resembles a slender form of *U. reticulata*, of which I should have been inclined to re-

gard it as a variety, were it not that the lower lip of the corolla is described as 3-lobed.

13. U. PREHENSILIS, *E. Meyer*, Comm. 282. Scapo (3–6 unc.) erecto v. volubili 2–4-floro, pedicellis erectis, corollæ labio superiore angusto oblongo obtuso integro v. leviter retuso calycem 2-plo superante, labio inferiore arrecto basi infra palatum angustato calcari dependente subulato-conico sæpius leviter antrorsum curvulo acuto æquilongo.—"*Herbula* rhizomate cæspitoso tenui albido fragili vesiculifero et foliifero, foliis erectiusculis lanceolatis vel ligulatis, basi longe in petiolum attenuatis, ... *Scapi* sæpius 1–3 aggregati 2–6 flori. Flores crocei . . . . . labium inferius obcordatum, patens, disco profunde 4-canaliculato, gibboso cristatum." *Calcar* lobo inferiore calycis 2–3-plo longius. *Capsula* calyce accrescente brevior. *Semina* matura anguste ovoidea tuberculata. A summo labii superioris corollæ ad apicem calcaris circiter 7 (6–8) lin. *Pedicelli* 3–4 lin. longi.

Welwitsch, Iter Angolense, no. 261. Distr. Huilla, "in uliginosis sylvaticis editis locis spongiosis de Morro de Lopollo (circa 5400 ped. alt.), socialis cum Xyrideis et Lycopodiaceis. Etiam in summis pascuis prope Humpata." Apr. 1860! Prope Omsancaba, *Drège*, no. 4839, *in herb. Hook.*!

This species resembles *U. Wallichiana* of India, and might be taken for a large-flowered variety of it. It differs in its less acutely cuspidate calyx-lobes, the upper lip of the corolla twice as long as the upper calyx-lobe, and tuberculate seeds.

β. *parviflora*. Scapo gracillimo, floribus minoribus, corollæ labio superiore calycem paulo excedente ovato-rotundato. *Flores* flavescentes unicolores (Welwitsch). *Corolla* a summo labii superioris ad apicem calcaris circiter 3 lin.

Welwitsch, Iter Angolense, no. 264. Distr. Pungo Andongo, "in uliginosis ad ripas rivuli 'Casā latê'; in præruptis de 'Pedra Songue.' Feb. and Apr. 1857."! On rocks in the rivers of the Sierra del Crystal, *Mann* (July 1862) *in herb. Hook.*!

14. U. TORTILIS, *Welwitsch, MS.* Scapo (4–6-unc.) volubili 1–5-floro, pedicellis gracilibus adscendentibus calycem æquantibus, corollæ flavescentis labio superiore integro calyci subæquilongo, calcari dependente conico acutiusculo calycem paulo excedente labio inferiori corollæ arrecto subæquali.—"Terrestris, radicis fibrillis albidis carnosulis ramulosis ramellis subcompressis hinc inde vesicula terminatis;" foliis tempore florifero evanidis. "*Scapus* filiformis digitalis spiraliter circa culmos Cyperacearum volubilis 1–4-florus. *Corolla* flavescens; labium superius integrum intus verticaliter purpureo-striatum; labium inferius subintegrum, gibbo-luteum, peripheria albido-flavescens . . . . *Capsula* (submatura) calyce omnino tecta." *Bracteæ* minutæ; *bracteolæ* sæpe desunt. *Calyx* lobis subæqualibus vix acutis.

Corolla calcari antrorsum leviter curvulo. A summo corollæ labii superioris ad apicem calcaris circiter $2\frac{1}{2}$ lin.

Welwitsch, Iter Angolense, no. 258. Distr. Huilla, "in paludosis spongiosis breve graminosis de Morro de Lopollo, semper cum Algis mucilaginosis socialis ad 5500 ped. alt.," Maio 1860.

This plant differs from the preceding in the absence of leaves at the time of flowering, its smaller flowers, the upper lip of the corolla about the same length as the upper calyx-lobe, and the spur but very little exceeding the lower sepal. It approaches *U. scandens*, Benj. and the voluble form of *U. Wallichiana*, Wt., —differing from the former in its pedicels, which ascend after flowering; from the latter in the sepals, which are not acutely cuspidate. It may probably turn out to be a variety of the latter species.

15. U. MICROPETALA, *Smith* (*A. DC. Prod.* viii. 19).
Sierra Leone, *Afzelius*, 1798.

Of this very singular species I have seen only the specimen in the Smithian herbarium. It differs from all other African species known to me in the proportionally enormous dependent spur, which appears to be four or five times as long as the small lower lip of the corolla.

In *U. capensis* and *U. livida* (under *b*) the pedicels are sometimes fully equal to the calyx in length.

Benjamin describes a *Utricularia* of Drège's in the 'Linnæa' (vol. xx. 314) which I am not able satisfactorily to identify, although it is apparently well described. Its diagnosis is as follows:—

16. U. LONGECALCARATA, *Benj.* "Scapo crassiusculo paucifloro, pedicelli capillaceis bracteis. . . . . 2–3-plo longioribus, lobis calycis æqualibus ovatis obtusis, corollae labio superiore oblongo emarginato, inferiore vix longiore late rotundato, calcari porrecto recto lineari subobtuso subduplo breviore.

Prom. B. Sp., *Drège*. Scapus 2-poll.; pedicelli $1\text{–}1\frac{1}{2}$ lin. longi. Corolla a summo labii superioris ad apicem calcaris $4\text{–}4\frac{1}{2}$ lin."

b. Flores sessiles v. subsessiles, v. pedicellis calyce sæpius brevioribus.

17. U. LINARIOIDES, *Welwitsch, MS.* Scapo stricto erecto (8–16-poll.) sæpius multifloro, floribus majusculis approximatis subsessilibus, labio superiore corollæ late quadrato-rotundato retuso calyce multo (ad 3–5-plo) longiore, labio inferiore galeato integro calcari cylindrico

subulato antrorsum falcato-curvato acuto æquilongo.—*Folia* obovato-spathulata longe petiolata (tempore florifero sæpe evanida). *Scapus* interdum furcatus, squamis basifixis minutis remotis paucis instructus, rachi inter flores sæpe flexuosa internodiis 3–9 lin. longis. *Bracteæ* bracteolæque basifixæ subæquales pedicellos brevissimos æquantes. *Calyx* lobis æqualibus, rotundatis, concavis. *Corolla* "intense purpurea, palato flavo-velutina," calcari acuto v. acutiusculo labio inferiore æqui- v. subæquilongo. *Capsula* globosa corolla marcescente obtecta. *Semina* minutissima. A summo pedicelli ad apicem calcaris 4–6 lin.

Welwitsch, Iter Angolense, no. 266. Distr. Huilla, "frequens in spongiosis juxta rivulos totius agri Lopollensis mox post pluvias vernales (ad 5000–5200 ped. alt.)," Oct. 1859!

18. U. Welwitschii, sp. nov. Scapo stricto erecto ad 5–12 poll. longo multifloro (5–16-floro), floribus aurantiacis sessilibus v. subsessilibus, corollæ labio superiore erecto late ovato-rotundato obtuso integro lateribus reflexis calycem fere duplo excedente, calcari subulato-cylindrico antrorsum curvato acuto labio inferiore fere duplo longiore, capsula globosa calycem paululo superante.—"*Folia* laxe rosulata elongato-spathulata, in spec. floriferis rarius obvia. *Calycis* lobi flavescentes (?) rubro marginati obtusi, inf. quidquam denticulatus. *Corolla* flava; labia sup. et inf. purpurascentia; palatum aurantiacum; calcar livido-purpureum acute conicum antrorsum et sursum flexum. *Scapus* constanter flexuosus in ejus parte fructifera." Scapus squamis minutis paucis basifixis instructus. *Floribus*, sub lente, minute puberulis. *Calyx* lobis æqualibus rotundatis. A summo corollæ labii sup. ad apicem calcaris circiter 3 lin.

Welwitsch, Iter Angolense, no. 263. Distr. Huilla, "in pascuis uliginosis . . . . . . sat frequens circa Lopollo," Nov. et Dec. 1859!

The scape is sometimes branched, the flowers alternating usually at intervals of 4–6 lines, though frequently approximated, along one-third to half of its length.

19. U. firmula, *Welwitsch, MS.* Scapo stricto erecto (sæpius 4–7 unc. longo) multifloro, floribus parvis sessilibus, labio superiore corollæ calycem superante apice bifido lobulis obtusis, calcari sursum infundibuliformi, dependente v. leviter antrorsum obliquo acutiusculo labio inferiore 3-lobulato parvo longiore.—"*Scapus* e foliorum radicalium rosula erectus, simplex v. bifidus pro more sat firmus. *Folia* obovato-spathulata. *Labium* (corollæ) superius flavicans, bilobum; inferius aurantiacum palato intense aurantiaco-rubro." *Scapus* squamis minutis paucis basifixis instructus. *Calyx* lobis æqualibus rotundatis. A summo corollæ labii sup. ad apicem calcaris $1\frac{1}{2}$–2 lin.

Welwitsch, Iter Angolense, no. 262. Distr. Pungo Andongo, "in humidis sylvaticis breve graminosis prope Sansamanda ad dextram flum.

Cuanza," Maio 1857! (? Island at Victoria Falls on the Zambesi) (*Dr. Kirk in herb. Hook.*).

The flowers are very numerous, and are scattered at short intervals along half or even more of the length of the scape. This plant is a near ally of the foregoing (*U. Welwitschii*), but differs in its smaller flowers and bilobed upper lip of the corolla. Dr. Kirk's specimens are stouter than those from Benguella. The flowers are not in a good state for examination, and the ovato-quadrate upper lip of the corolla is scarcely even retuse; so that I cannot feel sure it ought to be referred to the same species.

20. U. SANGUINEA, sp. nov. Scapo gracili erecto ($1\frac{1}{2}$–6 poll. longo), 1–4-floro, pedicellis bracteis æquilongis, floribus sanguineo-purpureis, labio superiore corollæ calycem superante oblongo v. obovato- v. cuneato-oblongo integro v. leviter emarginato, calcari subporrecto cylindrico acutiusculo apice antrorsum curvulo labio inferiori amplo quadrato-rotundato æquilongo v. paulo longiore, capsula calyci fere æquilonga subcernua.—"*Folia* spathulata carnosula fragilia. *Flores* lætissime sanguineo-purpurei" (*Welwitsch*). *Calyx* lobis æqualibus late ovato-rotundatis obtusis. *Semina* minutissima, sicca angulata. A palato ad apicem calcaris 2–5 lin.

This plant is near *U. capensis*. It may be distinguished by the different form of the upper lip, which is narrower below, and does not appear to have its margins reflexed at all, at any rate not so as to hide the upper lobe of the calyx. It appears very variable in the size of the flowers. In this respect, indeed, it by no means stands alone amongst the species of this section of *Utricularia*.

Welwitsch, Iter Angolense, no. 259. Distr. Huilla, "frequentissima in pascuis uliginosis, et imo in cultis relictis circa Lopollo ad 5000 ped. circiter super mare," Feb.–Apr. 1860! Magaliesberg, *Burke in herb. Hook.*!

21. U. PUBESCENS, *Smith* (*A. DC. Prod.* viii. 19).
Sierra Leone, *Afzelius*.

22. U. ARENARIA, *A. DC.* (*Prod.* viii. 20).
Senegal, *Perottet*.

I have seen but very imperfect specimens of this plant. I cannot identify it with any species occurring further south.

23. U. CAPENSIS, *Sprengel*, Syst. Veg. i. 50. Scapo gracillimo (1–6-poll.) sæpius 1–2–3-floro, pedicellis calyci æquilongis v. brevioribus, lobis calycis paulo inæqualibus, labio superiore corollæ ovato-rotundato breviter bifido v. late emarginato calycem superante, labio inferiore

amplo semiorbiculari leviter lobulato v. subintegro calcari oblique dependente cylindrico acutiusculo v. vix obtuso excedente v. subæquante.—*Folia* tempore florifero sæpius evanescentia. *Calyx* lobo superiore majore ovato-rotundato obtuso. *Corolla* labio superiore marginibus reflexis. *Capsula* globosa calycem paululo superans v. æquans, erecta v. subcernua. *Semina* minuta, matura compressa rotundata sub lente subtilissime tuberculata.

Cape of Good Hope, *various Collectors.*

The above description rests principally upon specimens of Drège's and Colonel Bolton's, the latter (in the Dublin University Herbarium) gathered near Grahamstown. It appears to be a variable plant, not only in the size of the flowers, but also in the form of the lobes of the bifid or emarginate apex of the upper lip of the corolla, and in the proportional length of the spur.

β. *brevicalcarata.* Calcari brevissimo saccato-conico obtuso labio inferiore corollæ 5–8-plo breviore, lobum inferius calycis interdum subæquante.

Giftberg, *Drège* (no. 7884) *in herb. Benth.* !

This may turn out to be a distinct species. The upper lip of the corolla may be either bifid with entire lobes or with the small lobes again emarginate.

24. U. LIVIDA, *E. Meyer.* Scapo elongato gracillimo simplici v. furcato subvolubili (8–12-poll.), 6–10-floro, floribus remotiusculis brevissime pedicellatis, pedicellis calyce brevioribus v. subæqualibus, labio superiore corollæ calycem fere duplo excedente, obovato- v. cuneato-oblongo apice rotundato integro, calcari subulato dependente v. porrecto recto v. apice leviter antrorsum curvulo labium inf. corollæ integrum excedente v. æquante, palato elevato crista tuberculata v. papillosa ornato.—Tempore florifero aphylla (in spp. nostris). *Pedicelli* erecti v. adscendentes brevissimi. *Calyx* lobis subæqualibus rotundato-ovatis obtusis, lobo inf. calyce 3-plo breviore. "*Corolla* ex violaceo et luteo livide variegata." A summo labii superioris corollæ ad apicem calcaris circiter 5 lin.

Described from specimens in Mr. Bentham's herbarium collected by Drège at Omsamcaba, South Africa.

25. U. EXILIS, sp. nov. Scapo erecto capillari (1–7-poll.), 1–2 (–4)-floro, floribus v. albis v. purpureis v. violaceis, remotis remotiusculisve brevissime pedicellatis v. subsessilibus, labio superiore corollæ oblongo v. ovato-oblongo obtuso integro v. leviter emarginato, calcari conico v. cylindrico-conico porrecto obtuso v. obtusiusculo labium inferius corollæ 2–3-plo excedente, capsula sphærica calycem paulo superante v. æquante.—*Folia* rosulata spathulata v. spathulato-ligulata sæpe ante florescentiam evanescentia. *Calyx* lobis subæqualibus rotun-

datis v. ovato-rotundatis. *Corolla* labio superiore calycis lobum superius paululo superante. A summo pedicelli ad apicem calcaris sæpius circiter 2 lin.

Welwitsch, Iter Angolense, nos. 252–256. Huilla, "inter Lopollo et Rio Ema, in arenosis humidis dumetosis, ad 5200 ped. alt."! (252); "frequentissima in pascuis pluviis vernalibus et autumnalibus inundatis," Humpata! (253). Pungo Audongo, "in spongiosis editis rupium 'Pedras de Guinga'"! (254); "in spongioso-paludosis prope Catete et Luxillo"! (255); "in arenosis . . . . parce herbidis ad lacum de Guibinda"! (257).

The specimens from Catete and Luxillo have pale violet flowers, the palate violet-purple, with the prominent yellow disk marked by radiating purple striæ,—raised lines or cellular papillæ, probably corresponding to which, are noticeable even in the dry state. Perhaps the specimens included under these numbers may belong to two or more species, but I fail at present to find any marks of adequate importance by which they may be separated and severally recognized. Colour, size of flower, and the form of the apex of the upper lobe of the corolla (whether entire or slightly emarginate or retuse) are all liable to vary in several species of *Utricularia*, sometimes in the specimens of the same gathering. Whether separated or kept together is not, I believe, very important; in either case they are very closely related. *U. exilis* must be near to *U. arenaria*, A. DC.; but that species is described with the spur equalling the lip of the corolla, while in *U. exilis* it is two or three times as long.

26. U. Sandersoni, sp. nov. Foliis rotundatis obovatisve gracillime petiolatis, scapo gracillimo (1–3-unc.) 1–2-floro, pedicellis brevibus calycem æquantibus, calycis lobis parum inæqualibus, labio superiore corollæ lilacinæ calycem 2–3-plo excedente erecto profunde bifido, labio inferiore amplo rotundato sinuato v. fere integro, calcari gracili elongato cylindrico obtusiusculo labio inf. corollæ longiore atque lobum inferius calycis 6–8-plo excedente, seminibus minutis ovoideis v. variis glabris.—*Calyx* lobo superiore majore rotundato, inferiore late quadrato-rotundato apice obscure 3-lobulato. Ab apice labii sup. corollæ ad extremum calcaris 5–6 lin.

On wet rocks near waterfalls, Port Natal, 1863, *Sanderson in herb. Trin. Coll. Dublin*! "Flowers pale lilac."

This species has rather the facies of the following section. The seeds, however, are not appendaged, and the calyx-lobes are but slightly unequal. Whether the plant emits stolons or prostrate shoots I cannot tell.

Utricularia Ecklonii, Sprengel (Syst. Veg. cur. post. 336) is so

wretchedly described that it is impossible to identify it, and the proper course appears to be to ignore the name.

Benjamin describes a second Cape species in the 'Botanische Zeitung' (1845, p. 213), which I have failed to identify in the herbaria which I have examined. It is

27. U. Lehmanni. Scapo substricto (1 poll. longo) raro 1- plerumque 2–3-floro, floribus subsessilibus, labio superiore corollæ erecto rotundato, inferiore duplo longiore dilatato apiculato, calcari cor. subæquilongo labio inf. approximato obtuso v. acutiusculo.—*Flores* approximati erecti. *Ped.* $\frac{1}{4}$ lin. longi. *Cor.* $1\frac{1}{2}$–$2\frac{1}{2}$ lin. longa, lutea v. fusco-lutea, striis saturatioribus notata.

§ 3. *Folia (sub anthesi sæpius persistentia) reniformia, orbiculata v. obovato-spathulata. Calyx lobis valde inæqualibus, inferiore minore. Corolla labio inferiore non galeiformi plus minus lobato. Semina (an semper ?) appendiculata, pilis v. spinulis instructa.*

28. U. orbiculata, *Wall.*
Camaroons, *G. Mann*, 5000 feet, *Dr. Hooker, Linn. Proc., Bot.* vii. 209.

On the Structure of *Bonatea speciosa*, Linn. sp., with reference to its Fertilization. By Roland Trimen, Memb. Ent. Soc. Lond. Communicated by Charles Darwin, Esq., F.R.S. & L.S.

[Read December 1, 1864.]

[Plate I.]

Mr. Darwin's remarks upon this curious and beautiful Orchid*, no less than his direct request that I should examine its structure, led me to search with care the neighbourhood of Cape Town in the hope of discovering it; but I met with no success. It was therefore with no ordinary pleasure that I received, through the kindness of Mr. Charles A. Fairbridge, one of the Trustees of the South African Museum, living flowers of *Bonatea speciosa*, which had expanded in a conservatory in Cape Town. The following details have been gathered from a careful examination of these flowers; and I trust that the accompanying figures will render them sufficiently intelligible.

The peculiar characters presented by the genus *Bonatea*, Willd., are given by Lindley and other authorities. It is sufficient to

* On the various Contrivances by which British and Foreign Orchids are Fertilized by Insects, &c., pp. 87, 302, 304, 330, 334.

observe that botanists agree in grouping it with *Habenaria*, Lindley remarking ('Gen. et Sp. Orchid.'), "*Bonatea* est *Habenaria* stigmate evolutissimo." My object here is limited to the illustration of the manner in which the structure of *B. speciosa* ensures the removal of the pollinia by insects resorting to the flower, and how fertilization ensues through the same agency.

The general aspect of the complete flower may be seen in figs. A. & B, of which the one gives a side, and the other a front view. The sepals, which are pale green, present nothing remarkable in form; but the two lower ones are sharply pointed and subfalcate, with their edges curled inwards underneath. The petals, on the contrary, are singularly shaped and greatly elongated. Each upper petal is divided almost to the base, with the green posterior portion standing erect, just within the margin of the upper sepal, and meeting at its apex the same portion of its fellow petal; while the white anterior portion projects almost at a right angle with the posterior, cohering, for a short distance, by its inner edge with the lower petal or labellum, and thence, widely diverging, becomes gradually broader, but somewhat abruptly narrows at the apex, which is prolonged and strongly recurved. The bright green labellum has a filiform dependent nectary as long as the ovarium, and is tripartite, its central lobe being much angulated, and depending between the lateral limbs, which project outward, more after the manner of the anterior portions of the upper petals.

The very remarkable cohesion of so many organs with the labellum has been correctly indicated by Mr. Darwin (*op. cit.* p. 304, note); and a reference to Fig. D will further illustrate this point. The long stigmatic processes (of which more hereafter) cohere on either side, for rather more than half their length, with the *upper* surface of the labellum; with its *outer* edges cohere, as has already been mentioned, the anterior portions of the upper petals for barely one-fourth of their length; and, finally, the inner edges of the lower sepals cohere with its *under* surface for about one-third of their length. It is thus clear that, as Mr. Darwin has pointed out, a section through the base of the labellum would divide these coherent parts also, passing in all through no less than *seven* (or, regarding the lateral limbs of the labellum as petaloid anthers of the outer whorl, *nine*) distinct organs.

The rostellum forms a very conspicuous green hood or helmet, constricted in its neck, and with the sides produced anteriorly into two long arms or horns projecting in an upward direction

and subconvergent. Its apex is similarly produced, but the process is shorter, and so recurved as to leave the front of the hood widely open*. The membrane at the anterior edge of the lateral horns is folded back throughout, forming grooves in which the caudicles of the pollinia (enveloped to their extremity in a continuation of the thin divided investing membrane of the pollen-masses) lie. The two disks are situated upon the apices of these horns, not far apart, with their viscid surfaces facing rather backward and towards the sides of the helmet. On each side of the base of the helmet, a little below the external edge of the groove containing the caudicle, is a small, thin, rounded winglet, which is an expansion of the membrane of the rostellum. These winglets evidently serve as guards against the escape of the very long and elastic caudicles from the grooves, which just there are widest and extremely shallow. It is very noticeable, that, immediately behind the winglets, the investing membrane of the caudicles (which lies free in the grooves) is firmly coherent with the column. The two widely-separated stigmatic surfaces are seated at the apices of a pair of wonderfully elongated white processes, having a common origin back in the neck, and at the base of the helmet, immediately behind the orifice of the nectary. These processes, cylindrical and apparently solid, are in reality tubular—the edges of each flattened expansion curling upward, and meeting very closely for about two-thirds of their length. Beyond this, the line of contact is marked, and the edges soon after diverge widely at the somewhat spoon-shaped and slightly concave surface of the stigma. The upper surface of the processes (forming the lining of the tubes) is very smooth and glossy, but not at all viscid.

It is not difficult to trace the perfect adaptation of the structure described to the removal of the pollinia and the subsequent fertilization of one or more flowers. An insect approaching the flower finds the opening of the nectary surrounded and guarded by the helmet-like rostellum. It seems probable that, as Mr. Darwin has shown in the case of *Angræcum sesquipedale*, the length of the nectary and the amount of nectar it contains are so contrived as to necessitate the hungry visitant's pushing even its head into the rostellum-cup in order to obtain the sweet fluid; and in such a case the attachment of one or both of the viscid

* The outer surface of the helmet (except the anterior portion of the lateral horns), as well as the *upper* surface of the recurved horn, is very minutely "shagreened" or roughened with points.

disks to some portion of the underside of the head or proboscis seems inevitable. It is right to mention that I found no nectar in either of the three nectaries that I opened; but it is possible that this was owing to cultivation in a greenhouse.

But supposing, on the other hand, that the nectary is well-filled with nectar, it would seem just possible, from the pollinia-disks being so far in front and the rostellum-helmet so widely open above, that a moth or fly with a long and flexible proboscis might obtain nectar without removing either pollinium. Few persons, indeed, who have watched the impetuous eagerness with which *Sphingidæ* and the larger *Noctuæ* rifle the honey of flowers, would consider it likely that the rapidly probing proboscis could avoid both disks—especially in the case of a *Noctua* (and of most Dipterous flies), which would certainly alight on the convenient landing-place afforded by the many cohering organs, and have to stretch its proboscis, if not its head, over the projecting arms of the rostellum. Yet such a chance does exist, and nature has provided against it. Immediately in front of the orifice of the nectary, back in the throat of the helmet, a stout, erect, white process or peg, rather more than a line in length and very slightly curved forwards at its apex, springs from the central portion of the labellum, and effectually bars any direct access to the nectary, only leaving a very small space on either side of it, through which the proboscis can be inserted (see fig. E). An insect is therefore compelled to make its approach to the nectary a little to one side or the other, and thus the attachment of one of the backward and laterally facing disks is absolutely ensured.

A pollinium once withdrawn, the mere weight of the pollen-mass causes it to hang downward, but the strong natural curve *in situ* of the very long caudicle is not thus overcome to any great extent, but is so far retained as to project the pollen-mass considerably beyond the line of a downward perpendicular from the disk (see fig. F). The position thus naturally assumed is admirably calculated to effect the attachment of pollen-grains to the viscid surface of the strangely produced and slightly dependent stigmas, which no pollinium with a shorter caudicle would be likely to reach. Nothing could be more interesting than the certainty with which the pollen-masses, when attached to a slender pin which had been and was anew pushed into the nectarial orifice, invariably struck the stigmas of the many flowers that I fertilized on the growing plant in Mr. Dickson's conservatory.

The most remarkable point in the structure of this Orchid is

undoubtedly the erect process of the labellum. Its sole use and object are so unmistakeable, and its abrupt prominence seems so foreign to the general character of the labellum and petals, that it would be difficult to find, even in the Orchidean order, a more striking instance of special modification. With the exception of this local development of the labellum, no part of the perianth appears directly to conduce to the fertilization of the flower; but the extraordinary modification of the columnar organs effects what is required. The lateral petals, which in so many South African *Ophreæ* are of the utmost importance, are of no direct service in *B. speciosa*, nor do I perceive the object of their marked posterior development, unless it be the strengthening of the protection afforded to the pollinia by the upper sepal. The prominent and magnificent group of cohering sepals and petals appears to serve the purposes of protecting and supporting the stigmatic processes, and of affording a convenient landing-place for insects. Possibly, too, its singular form may give it some attractive influence.

I am unable to supply any details as to the extent to which insect fertilization is effected in this Orchid, having had no opportunity of observing the plant in its native localities. But, presuming the supply of nectar to be good, nothing seems wanting to ensure very frequent fertilization. The plant to which I have had access was brought from Kuysna, on the southern coast of the colony.

R. Trimen.

Colonial Office, Cape Town,
October 7, 1864.

EXPLANATION OF THE PLATE.

A. Side view of complete flower.

B. Front view of complete flower, rather from above.

C. Side view of column, with all the sepals and petals removed except right upper petal.

D. Under surface of labellum, showing cohering lower sepals, and anterior limbs of upper petals which cohere with upper surface. (Apices of stigmatic processes visible on either side of central limb of labellum.)

E. Front view of portion of column (pollinia removed from anther-cells) with posterior limbs of upper petals attached, and rostellum cut away to show erect process of labellum preventing easy access to nectary.

F. Pollinium in its natural dependent position when attached by viscid disk to a pin and withdrawn from anther-case.

u. s.	Upper sepal.	*pl.*	Pollinia.
l. s.	Lower sepals.	*c.*	Caudicle of pollinium.
u. p.	Upper petals.	*r.*	Rostellum.
l.	Labellum.	*dd.*	Viscid disks.
n.	Nectary.	*ss.*	Stigmatic surfaces.
o.	Ovarium.	*pr.*	Process of labellum.

Notice of two Forms of *Eriophorum angustifolium*. By George Dickie, M.D., F.L.S., Professor of Botany, Aberdeen.

[Read Dec. 15, 1864.]

On 13th May last I happened to visit a locality near Aberdeen where *Eriophorum angustifolium* is rather plentiful; the moor is one of the few places near town which, being still uncultivated, yields a considerable number of wild plants. The *Eriophorum* was in full flower, and there were obviously two forms of it, one with slender spikes having only stigmas visible, the other with shorter and blunter spikes with very prominent anthers and short stigmas; specimens of both were collected for more careful examination. In the forms having stigmas alone visible, I found on dissection that in each flower there were three stamens in a rudimentary condition; and at a later date, May 28th, I found them in the same state, anther and filament together measuring only from a twentieth to a fifteenth of an inch in length, and without a trace of pollen. In the other form the anthers were large and prominent, yielding copious pollen; the stigmas were shorter than the stamens, but were apparently well formed although shrivelled; they had evidently exercised their special function, and this at the time when the stigmas of the other form were still fresh and their tissues full of fluid.

About the end of May the cotton-like appendages were beginning to protrude beyond the bracts in both forms. Plants of each were carefully marked for farther observation; and lest the marks should be accidentally removed or the plants injured by cattle, several were transplanted and kept in a greenhouse that their progress might be noted. It may be necessary to state that the plants were scattered over a surface about an eighth of a mile long by the same in breadth; in four different parts of the moor I found that the two forms grew quite separate from each other, several yards apart. At only one spot they were intermixed, and here I endeavoured to ascertain whether the two had any connexion underground, I failed in tracing any.

In both forms the seeds apparently reached full ripeness, and on dissection there was no apparent difference. The power of germination being, however, the proper test, about forty seeds of each form were sown under precisely the same conditions. Almost every seed of those from the plants with large anthers and short stigmas sprang and continued to grow; not more than five or six of the seeds from the other form showed any sign of life: the ex-

periment was repeated with the same result. It may be necessary to state that the seeds were taken from plants of the two forms growing several yards apart; seeds from individuals growing intermixed were unfortunately not secured for experiment: it is probable that the result would have been different, close proximity of the two being more likely to insure fecundation of the one by the other.

The genus *Eriophorum* is usually defined as hermaphrodite; at least one species must be considered an exception, *E. angustifolium* having two forms, one truly hermaphrodite, the other structurally bisexual, but virtually unisexual, the stamens remaining rudimentary and producing no pollen. Having examined some duplicates of this species from the shores of Davis Straits, I find that they also have the two forms.

It is usual to speak of plants as either hermaphrodite or else bisexual, but in this respect animals and plants may not in every case be strictly parallel. If, as I presume is the ordinary view, flowers of most plants high in the scale are really composite in their nature—as the entire plant is—then only can we say in strict terms that a flower with a single stamen and a solitary pistil is hermaphrodite; such a case may, however, be either homomorphous or heteromorphous. In cases where several perfect stamens occur, either in one whorl or in more than one, there may be only apparent homomorphism; I presume it has not been proved that the pollen of each individual stamen is equally capable of fertilizing the pistil or pistils of that flower. May there not be cases in which stamens of the one whorl are intended to influence the contiguous pistil, and those of the other to fertilize, by various agents, the ovules of some other flower? This is mere conjecture, but there may be some ground for it when we remember that different stamens in the same flower attain maturity at distinct periods, and, in some cases, stigmas and stamens in the same flower also differ in this respect. Plants in which dehiscence of anthers is extrorse also deserve consideration in relation to this subject.

Notes upon a few of the Plants collected, chiefly near Nagasaki, Japan, and in the Islands of the Korean archipelago, in the years 1862–63, by Mr. RICHARD OLDHAM, late Botanical Collector attached to the Royal Gardens, Kew. By Professor OLIVER, Keeper of the Herbarium and Library, Kew.

[Read Dec. 15, 1864.]

HAVING recently had the arranging and distributing of the Japanese and Korean archipelago collections sent home by Mr. Oldham, my attention has been attracted by several plants which it contained of special interest, either undescribed species, or belonging to genera new to the Japanese Islands. As might have been expected, there are amongst them a few more Himalayan species now first added to the Japanese flora; one or two of these belonging to the number which turn up again in the Atlantic States.*

The species of many genera which have not been well monographed of late, or which, from other causes, required more time for their accurate discrimination than could be afforded, were distributed simply under the generic name and catalogue-number. These will no doubt be included in the 'Flora of Japan' upon which M. Maximowicz is at present engaged, and for which work he has himself collected a very large amount of material.

Much credit is due to Mr. Oldham for the careful selection of his specimens, and their good state of preservation.

Sabia. A species differing from any described in the 'Flora Indica' of Drs. Hooker and Thomson, with yellow flowers in fascicles of two or three, from the axils of fallen leaves, was sent from Nagasaki in a previous collection arranged by Mr. Black, who rightly noted it as a distinct species. Its fully developed leaves are wanting, so that I cannot give a diagnosis at present.

Geum japonicum, Thunb., Nagasaki. I cannot refer the plant sent to *G. strictum*, Ait., which species, however, occurs in Japan. It is distributed, without doubt, under Thunberg's name. It differs from *G. strictum* principally in its stem-leaves, which are never sharply cut. It may be diagnosed thus:—

G. caule flexuoso, foliis petiolatis trifoliolatis, foliolis cuneato-obovatis, vel unifoliolatis e basi truncata v. late cuneata rotundato-ovatis ob-

* See the important Essay on the relations of the Japanese Flora, by Prof. Asa Gray, in Memoirs Amer. Acad. new ser. vi. p. 377.

[Since these notes were read we have received from China the painful intelligence of Mr. Oldham's death.]

scure 3–5-lobatis, crenatis, molliter pubescentibus; petalis calycis lobis subæquantibus.

The stipules are smaller than is usual in *G. strictum* and less deeply incised.

ITEA JAPONICA, sp. nov. Glabra v. glabriuscula; foliis membranaceis, ovato-ellipticis v. ovatis acuminatis argute serratis, racemis terminalibus, folio duplo longioribus, calyce scutelliformi basi truncato, ovario glabro disco annulari conspicuo cincto, stylo brevi.

Nagasaki (in hort.).

Differs from *I. nutans* of the N.W. Himalaya in its smaller, more acuminate, membranous leaves and shallow truncate calyx. The petals, stamens, and style are much shorter than in *I. virginica*, in which species the disk is inconspicuous or obsolete. *I. japonica* combines, however, some characters of both of these species. *I. chinensis*, which occurs in the Loo Choo archipelago, is not yet recorded from Japan.

Rhodotypos. Specimens in advanced fruit of this little known plant were obtained in a garden at Nagasaki.

EUCHRESTA JAPONICA, *Bth.*, sp. nov. Foliis trifoliolatis coriaceis glabris, foliolis e basi sæpius obtusa obovato-ellipticis obtusis v. apice interdum late et obtusiuscule breviter productis, lateralibus oppositis brevissime petiolulatis, terminali sæpe paulo majore, racemo terminali puberulo 10–30-flor; bracteis minutis; pedicellis erectis.

Woods near Nagasaki.

A low unbranched shrub, erect or slightly decumbent at the base, 1–1½ feet high, with a more or less thickened tap-root branched a little below. Stem terete, with smooth green bark, glabrescent below, puberulent above. Petiole to first pair of leaflets 1½–2½ in., beyond 3–6 lines; obscurely articulated immediately below the terminal leaflet. Terminal leaflet 2–4 in. × 1¼–2¼ in. Fruit pedicels ascending, 3–4 lines. Stipes of 1-seeded, shining, black, ellipsoidal fruits, about 2 lines.

E. japonica differs from *E. Horsfieldii*, Benn., at sight in its leaves, which in all our specimens are trifoliate, and the obovate, obtuse leaflets. Specimens of a *Euchresta*, scarcely specifically different from *E. Horsfieldii*, are in the Hookerian Herbarium from Formosa (Wilford), and Sikkim and Khasia (Drs. Hooker and Thomson, undistributed).

Amphicarpaa Edgeworthii, Bth., var. *japonica*. Gathered near Nagasaki. Probably both the West Himalayan and Japanese plants may be referred to *A. monoica* of the United States. *A. ferruginea*, Bth., of the Himalaya is quite distinct. The leaflets

of the Japanese plant are more obtuse than in *A. Edgeworthii*, and the calyx-segments are larger and more acuminate than in the specimens of *A. monoica* which I have seen. The spur-like appendages of the lamina of the wing-petals are nearly like those of the American plant.

Atylosia, a voluble species, probably new, from Nagasaki. The marcescent corolla persists, but the valves of the legumes, though slightly depressed between the seeds, are not marked by transverse lines.

Wistaria chinensis, DC. There seems to be considerable difference in the calyx of this plant. Sometimes it is nearly truncate, with the upper lip entire and the three lobes of the lower lip triangular or deltoid; sometimes the upper lip is bifid and the lobes of the lower lip lanceolate-acuminate, the median lobe nearly equalling the tube in length.

Aeschynomene indica, L. Nagasaki.

Desmodium Oldhami, sp. nov, § Podocarpium. Herba erecta v. adscendens, gracilis; foliis impari-pinnatis (sæpius 7-foliolatis) foliolis petiolulatis (lateralibus oppositis, superioribus et terminali sæpius majoribus) ovalibus vel lanceolato-ellipticis v. lanceolatis leviter acuminatis acutis v. acutiusculis, sparse pilosis, estipellatis, racemo piloso-pubescente elongato, legumine pubescente gracile stipitato articulis solitariis binisve.

The plant is slender, 2–4 ft. high, unbranched, or with one or two branches from the lower part of the raceme; glabrous below, shortly pilose or pubescent above and throughout the raceme. Leaves variable in size, usually 5–10 inches, petiole to lowest pair of leaflets $1\frac{1}{2}$–3 ins. Terminal leaflet $1\frac{1}{2}$–$4 \times \frac{3}{4}$–$1\frac{1}{2}$ in. Raceme 6–10 ins. Flowers solitary or fascicled in twos or threes; pedicels slender, equalling or exceeding the linear-subulate bracts; calyx sparsely pilose, two upper teeth connate, three lower short, broadly triangular. I have seen only very young legumes; the sides of the semi-obovate articles are minutely pubescent, the margins glabrous. I am not sure of the precise locality of this plant. It is probably from the neighbourhood of Nagasaki, though it may have been collected in the Korean archipelago. A second pinnate-leaved *Desmodium* is in the Hookerian Herbarium from the Isle of Pines. Excepting in the leaves, it resembles *D. polycarpum*.

Lespedeza. Oldham sends six or seven species, which require more careful examination than I have yet given them. Amongst them are specimens, from Nagasaki and also from the Korean

Islands, of *L. villosa*, Pers., a plant once supposed to be of North American origin.

Dasyloma, Nagasaki. Near *D. laciniatum*, Miq.; perhaps a variety of *D. glaucum*, DC.

Viscum album, L. var. Under this name a few specimens are distributed of a Mistletoe, said to be from Fusiyama. I think it very probable that Kæmpfer's plant *(V. Kæmpferi*, DC.*)* may be the same.

Enkylia, Griffith. A slender Cucurbit from Nagasaki, with male flowers only, belongs to this genus and probably to an Himalayan species, referred to *Zanonia* by Wallich.

Turczaninowia, Nagasaki. A plant agreeing well with the *T. fastigiata* figured by DeCandolle (Structure et Classification des Composées, &c., p. 20, t. iv.), unless it be that the lateral nerves of the leaves are rather more marked. The achenes, however, are hairy, and I find this distinctly the case also in Turczaninow's Dahurian *Aster fastigiatus*, preserved in the Hookerian Herbarium, the plant upon which *Turczaninowia* was founded by DeCandolle. The pappus is uniserial and subequal, and the radiate florets are fertile in both. I suppose the genus must merge into *Aster*.

Ludwigia, a species near to the Indian *L. diffusa*, Ham., Nagasaki.

Leptocoma racemosa, Less., Nagasaki. Agrees well with the Himalayan plant, as shown me by Dr. Thomson.

Parechites Thunbergii, A. Gray. This name was merged as a synonym of *Rhynchospermum jasminoides* by my friend Mr. Black in his list of Japanese plants. The plants so named are probably identical. Oldham, however, sends fruiting specimens which show that this plant is no *Rhynchospermum*, the coma being sessile. Under the circumstances therefore it must remain in *Parechites*. It is very unfortunate that the fruit of the original species of this genus should be undescribed. It is consequently just possible that the Japanese plant may some day require another transfer. It was published by Professor Miquel. Dr. Thomson has directed my attention to the close similarity of *Ichnocarpus fragrans*, Wall. (treated as a doubtful *Ichnocarpus* by A. DeCandolle in the Prodromus), to *P. Thunbergii*. They appear to be congeneric; perhaps, indeed, conspecific. The seed of the original *Rhynchospermum* (*R. Wallichii*, A. DC.) is terminated by a long slender beak.

Asclepiadea, spec. dub. Oldham sends from Long Reach, Korean archipelago, a twining Asclepiad with linear lanceolate, acuminate, petiolate, obsoletely pubescent leaves, 3–5 ins. long, with

a narrow cordate base, and small flowers, like those of a *Metastelma*, in numerous lateral shortly pedunculate small umbels. I am at a loss to know what to do with it. Here is a description of the flower.

Calyx 5-fidus, lobis lanceolatis, ciliolatis, corolla dimidio brevior. Corolla breviter campanulata v. subrotata ad medium 5-fida, lobis ovato-oblongis, obtusis, intus pubescentibus. Corona staminea gamophylla, ad basin 5-partita, lobis gynostegio truncato incluso paululum brevioribus, triangulari-ovatis, obtusis, inappendiculatis. Pollinia geminata, pendula, minuta. Stigma obtusum, obsolete bilobum.

Mephitidia, sp.? in fruit from Nagasaki.

Phryma leptostachya. Recorded by Maximowicz in Amurland, it is at last sent from Nagasaki.

Hygrophila salicifolia, Nees. This common Indian plant grows at Nagasaki.

SCROPHULARIA OLDHAMI, sp. nov. Glabra, caule tetragono vix alato, foliis petiolatis, e basi rotundata v. truncato-rotundata v. subcuneata ovato-lanceolatis v. ovatis, acutis, serratis, petiolo inappendiculato, thyrso elongato multifloro spiciforme aphyllo, cymis densis v. subdensis breviter pedunculatis puberulis glabrisve, calycis lobis ovatis v. ovato-rotundatis corollæ tubo dimidio brevioribus, anthera sterili obovato-spathulata v. rotundata integra labio posteriore corollæ breviore.

Nagasaki.

An erect, unbranched plant, 2-4 ft. tall, with sharply serrate leaves; sometimes the lowest tooth on each side is larger than the rest, forming a small lateral basal lobe. Bracts linear. "Flowers yellowish."

Orobanche. Oldham sends a species from Nagasaki.

Utricularia vulgaris? A submerged leafy axis only, but probably of this species, is sent from Nagasaki. *U. intermedia* only of this genus had been previously recorded from Japan.

Orthodon, Benth.* A new genus of Labiatæ. § *Satureieæ*.

Calyx campanulatus, subæqualis, 10-nervius, 5-fidus, intus nudus, fructifer basi æqualiter gibbus, fauce contracta. Corolla tubo calyce breviore, exannulato, lobi 4 æquilongi, breves, summo emarginato, infimo lateralibus fere duplo latiore. Stamina corolla breviora, distantia, 2 superiora perfecta antherarum loculis divergentibus, 2 inferiora antheris parvis cassis. Ovarium a basi 4-lobum. Stylus apice subæqualiter bifidus. Nuces (sub lente) areolato-rugosæ.

O. japonicum, sp. unica. Nagasaki; the edges of woods.

Fl. September (no duplicates were sent for distribution).

Herba annua, erecta v. diffusa, 4–8 poll., ramosa, ramis sæpius oppo-

* For the generic diagnosis I am indebted to Mr. Bentham.

sitis patentibus v. patentim divaricatis, pilis brevibus patulis piloso-pubescentibus. Folia petiolata, superiora subsessilia, ovata v. ovato-oblonga v. lanceolata, obtusa v, obtusiuscula, remote crenato-serrulata, utrinque sparse pilosa v. subtus deinde glabrescentia, 4–8 lin. × $2\frac{1}{2}$–$4\frac{1}{2}$ lin,, petiolo piloso 1–2 lin. longo. Flores inconspicui, circa $1\frac{1}{2}$ lin. longi, in axillis foliorum superiorum floralium caulinis conformium solitarii, brevissime pedicellati v. subsessiles.

Orthodon would appear to rank near *Mentha* and *Lycopus*; in some respects it approaches *Isanthus*, formerly placed in the same neighbourhood by Mr. Bentham.

Lindera mollis, sp. nov. (Lindera § *Palminerviæ*, Meissn.)

Arbor, innovationibus laxe pilosis mox glabrescentibus, foliis triplinerviis petiolatis promiscue integris et lobatis, circumscriptione cordatis vel late quadrato-ovatis e basi cordata (in foliis indivisis) vel truncato-rotundatis medio in petiolum breviter cuneato-acutata (in foliis trilobulatis), lobis obtusis lobo medio ovato-deltoideo lateralibus superante, subtus præcipue ad nervos dense cinnamomeo-sericeo-pilosis, supra glabris glabrescentibusve nervis parce pubescentibus pallidis exceptis, floribus fasciculatis, pedunculo sparse piloso.

Henschel Island, Korean archipelago, 1863.

Arbor 25-pedalis. Folia minora sæpius indivisa, majora apice 3-lobata sinubus rotundatis, sæpius 2-4 poll. longa atque lata; petiolus $\frac{3}{4}$-1 poll., pilosus. Pedunculus fructiferus 6–8-lin. apice paululo incrassatus.

Veitchia japonica, Ldl. Mr. Oldham sends several specimens under this name, which he obtained at Yokohama, said to have been brought from Fusiyama. They consist of the branches of an *Abies*, bearing pseudo-cones of various size, precisely similar in form and structure (though mostly much larger) to those which, owing to insect punctures, infest *Abies alba* and *A. excelsa* in our plantations. I cannot doubt but that it was from fragmentary specimens of these malformations that the genus *Veitchia* was proposed in the 'Gardener's Chronicle' (1861, p. 265), though Dr. Lindley was no doubt misled by some seeds supplied to him, which he understood were produced by the cones in question. I cannot be sure of the species of *Abies*, as none of the normal cones accompany the specimens.

A specimen of another tree said to grow on Fusiyama, was obtained at Yokohama, which I cannot refer with certainty to its natural order. It is probably a new Bixineous type. The tree is said to be called "*Kara Sendan*" (or Sendau) by the Japanese. But a single fragment in fruit only was sent. It consists of the extremity of a branch with glabrous, red-brown, lenticellate

bark, with two alternate 5–7 palminerved, cordate or ovate-rotundate, remotely serrate, acute (?), glabrous, exstipulate leaves with a cordate or truncate-cordate base and very long petioles. Lamina 5–6 in., petiole 6–7 in. The branch terminates in a racemose panicle 1 foot long, of numerous, pedicellate, depressed-globose, shining, brownish black, dry, baccate, superior fruits 4–6 lin. in diameter, marked on the top with the circular scar of the style. The pedicels are articulated at the base, rather angular and obsoletely pubescent. The fruit is one-celled with indefinite seeds apparently distributed in about six parietal vertical series, but their arrangement is obscured by a quantity of pulp. On dissecting the pulp out of the thin pericarps, six woody rays are found projecting into the cavity at the base of the fruit, doubtless the remains of the vascular cords supplying the placentæ, and which were embedded in the inner layer of the ovary previous to its pulpy change. The seeds are ovoid-globose, smooth, semi-anatropous with a crustaceous testa, albuminous, with the straight embryo nearly equalling the fleshy albumen; the flattened cotyledons equalling the terete radicle. Any botanist visiting Japan would do well to bear it in view.

SAGITTARIA, an sp. nova? (§ Folia linearia; flos fertilis sessilis, filamentis dilatatis.) Parva, foliis late linearibus sæpius plus minus falcatis apice angustatis obtusiusculis, scapo simplici paucifloro (3–7-floro), flore fertili solitario, floribus sterilibus pedicellatis.—Leaves $2\frac{1}{2}$–4 in. × 3-4 lin. Scape rather exceeding the leaves (4–6 in.). Flowers nearly white. Pedicels of male fl. $\frac{3}{4}$–1 in.

Nagasaki.

Lilium? medeoloides, A. Gray. Oldham sends from the Korean archipelago, a *Lilium* which I take to be Prof. Gray's plant, originally described from a single specimen. The flowers are said to be "bright orange-red"; they are either solitary or two or three together. The leaves of the single pseudo-verticil vary in number from 3 to 14 or so, and are narrow-oval or oblanceolate, often subacuminate, scarcely acute, or rather obtuse, and often narrowed to the base.

Aneilema, near *A. triquetrum*, Wall. Nagasaki.

Empusa paradoxa, Ldl. Nagasaki, on hill-tops, 800–1500 ft. "Flowers nearly orange-yellow." I cannot find any difference between the Japanese and Himalayan plants.

Aceras, very near *A. angustifolia*, Ldl., but the lateral petals are ovate-oblong. "Flowers yellowish, amongst grass on hill-tops." Nagasaki.

Isolepis squarrosa, Vahl. This Indian weed occurs in Japan.

Carex macrocephala, Willd., *β. longibracteata*.

Korean archipelago.

C. spica oblongo-ovoidea v. ovoidea, bracteis erectis rigidis ovato-lanceolatis longe cuspidato-acuminatis, spiculis multo longioribus, infima dimidium spicæ superante, spiculis 18–30 confertis sæpius 2–3-floris, fructibus maximis ovato-lanceolatis rostratis nervosis inferne vix alatis sursum marginatis leviter laciniato-denticulatis squama ovata cuspidata ∞-nervosa æquilatis et æquilongis v. paullo superantibus.—Culmi validi erecti 6–9-poll. trigoni glabri striati, foliis coriaceis linearibus acuminatis glabris cartilagineo-serrulatis breviores v. fere æquilongi. Spica $2–2\frac{1}{2} \times \frac{3}{4}–1$-poll., erecta. Bractea infima e basi ovata amplectente linearis $1\frac{1}{2}$–2-poll., superiores circa 1-poll. ($\frac{3}{4}–1\frac{1}{4}$).

Although looking very like a distinct species, I think it will turn out a variety of *C. macrocephala*, notwithstanding its fierce, ovate-lanceolate, acuminate bracts, and perigynia scarcely alate below. No stamens were found. They had probably been long fallen from the terminal glumes of the short spikelets.

On Five New Genera of West Tropical Africa, belonging to the Natural Orders Bixineæ, Tiliaceæ, and Anonaceæ, with a Note upon the Genera *Oncoba* and *Mayna*. By Professor OLIVER, Keeper of the Herbarium and Library, Kew.

[Read Dec. 15, 1864.]

BIXINEARUM genera nova.

1. DASYLEPIS. (§ *Pangieæ*.)

Flores hermaphroditi (v. polygami). *Sepala* 4, basi coalita, orbicularia, concava; æstivatione imbricata, 2 opposita exteriora. *Petala* 4 cum sepalis alterna, imbricata, subperigyna, libera, basi squamis totidem parvis crassiusculis pilosis antepositis adnata. *Stamina* indefinita (24–30), leviter perigyna, libera, filamentis lineari-subulatis anthera æquilongis v. longioribus; antheræ compressæ, glabræ, lineari- v. lanceolato-oblongæ muticæ, basi cordato-sagittatæ, rima longitudinali dehiscentes. *Ovarium* liberum, glabrum, in stylum indivisum ovarium æquantem angustatum; placentæ 2–3 vel 4, multiovulatæ. *Stigma* brevissime 2–3–4-lobum, lobis erectis, acutiusculis. *Fructus* deest.

1. D. RACEMOSA, sp. unica.—Camaroon Mountains, 2–3000 feet, *Mr. Gustav Mann.*

Arbor glabra, ramulis teretibus. *Folia* alterna, subcoriacea, petiolata, e basi cuneata elliptica v. ovalia, 6–9 poll. longa, $2\frac{1}{2}$–$3\frac{1}{2}$ poll. lata, breviter atque obtuse acuminata, ultra medium remote denticulato-serrata, utrinque glabra, penninervia, v. basi vix subtriplinervia, nervulis lateralibus subter prominentibus. *Petioli* 4–6 lin. longi. *Stipulæ* parvæ deciduæ. *Flores* mediocres 6–8 lin. lati, in racemos axillares multiflores folio dimidio breviores dispositi, bracteati, bracteis minutis, rotundatis, squamiformibus; pedicelli stricti 3–6 lin. longi, basi articulati.

2. PYRAMIDOCARPUS.

Flores hermaphroditi, parvi. *Calyx* 3-fidus, lobis rotundatis crassiusculis, æstivatione late imbricatis. *Petala* 7–10 tubo calycis inserta, lobis ejusdem subsimilia, a calyce gradatim minora (interiora interdum verisimiliter subantherifera). *Stamina* indefinita (16–25) 2–3-serialia (alabastro ut videtur libera), tubo calycis inserta; antheræ basifixæ ovato-oblongæ v. lineari-oblongæ muticæ, rima submarginali dehiscentes. *Ovarium* liberum, uniloculare; placentæ 4 v. 3, multiovulatæ; stylus brevis, crassiusculus, stigmate breviter 4- v. 3-fido, lobis erectis v. recurvis. *Fructus* coriaceus e basi ventricosa breviter pyramidatus, tetragonus v. trigonus, apice stylo brevi persistente apiculatus, oligo- v. polyspermus, maturitate loculicide dehiscens. *Semina* glabra testa chartaceo-coriacea, per compressionem forma varia; embryo albumine carnoso brevior, cotyledonibus foliaceis latis, basi vix cordatis v. subcordatis radicula crassiuscula subæquilongis.

1. P. BLACKII, sp. unica.—River Muni, W. Tropical Africa, *Mr. Gustav Mann.* Aug. 1862 (in bud and ripe fruit). No. 1775.

Arbor parva (25-pedalis), omnino glabra. *Folia* alterna, petiolata, stipulata, coriacea, oblongo-elliptica, cuspidata v. breviter acuminata remote et subtiliter denticulata, pennivenia; lamina $6–8 \times 2\frac{1}{2}–3\frac{1}{2}$-poll.; petiolus 5–9-lin. *Stipulæ* caducæ. *Flores* parvi (verisimiliter 1–3-lin. diametro), alabastro sphærici, in spicas breves $\frac{1}{2}$–1 poll. longas, brevissime pedunculatas v. sessiles, solitarias v. 2–3-fasciculatas, piperis spicam fructiferam revocantes dispositi; bracteæ minutæ. *Fructus* lateribus medio (sutura dorsali) longitudinaliter carinatis, a basi ad apicem 9–12-lin.; diametro diagonali 9–15-lin. *Semina* $4–5 \times 2–3$-lin.

Pyramidocarpus is one of those perplexing monotypic genera which do not present very near affinity with any recognized group. The small flowers and decidedly perigynous insertion of

the petals and stamens point in the direction of *Banera* and its allies in Samydeæ, but the habit of the plant, the texture of its flowers and broadly imbricate calyx-lobes appear preponderant in favour of Bixineæ, if maintained as distinct from Samydeæ, and for the present it may be regarded as an anomalous member of the tribe Flacourtieæ of that family. I have not seen expanded flowers, and it is probable that the perigynous condition of the petals and stamens may be proportionally less marked when they are fully developed. I have associated with this fine species the name of our Associate Member, Mr. Allan Black, until recently my colleague in the Kew Herbarium and now Superintendent of the Bangalore Botanic Garden, he being the first to dissect its flowers and to determine its probable affinity.

I believe that it will be necessary to unite the genera *Oncoba* and *Mayna*. At the time when Mr. Bentham published his "Notes on Bixaceæ and Samydaceæ" in the Society's Journal (vol. v., Bot., Suppl. ii. p. 75), and when the generic descriptions were framed for the new 'Genera Plantarum,' such a contingency could hardly have been contemplated. But, thanks to Mr. Gustav Mann, to whom we are so largely indebted for many important additions to the Flora of Western Equatorial Africa, and to Dr. Welwitsch, we now possess seven or eight new species belonging to those genera which, to the best of my judgment, entirely break down all ground of generic distinction between them. Indeed, in some of the new species so intermingled are the characters which were formerly depended upon for the discrimination of these genera that it is difficult to arrange the species under even well-marked subgenera or sections. They all agree in having a simple style, and this technical character may suffice to maintain them as generically distinct from *Carpotroche* and *Dendrostylis*, in which the style is divided more or less.

The principal marks distinguishing the genera *Oncoba* and *Mayna*, which were relied upon when the known species of *Oncoba* were limited to four, with large flowers, from Tropical Africa, and of *Mayna* to six or seven with small flowers from Tropical America, were the large, terminal flowers, radiate stigma and smooth fruit of the former, the small flowers in axillary racemes, with a minute stigma and echinate fruit of the latter. Amongst the recently discovered African species we have the flowers of *Oncoba* with echinate fruit, with minutely divided stigma, and in axillary fascicles or racemes, as well as flowers intermediate in size be-

tween *Oncoba* and *Mayna* in an almost complete series. Neither the number of placentæ and corresponding divisions of the stigma, nor the proportion of petals to sepals, nor the structure of the anthers (which are not a little variable) appear available excepting for minor subgeneric divisions or the discrimination of species. Appended is a short amended description of *Oncoba* as I propose to leave it.

Oncoba, *Forsk. Fl. Ægypt.-Arab.* 103 (1775); *Benth. & Hook. fil., Gen. Pl.* i. 125 cum syn. Mayna, *Aubl. Pl. Gui.* 921 (1775); *Benth. & Hook. fil. l. c.* cum syn.

Flores polygami. *Sepala* sæpissime 3, rarius 4 (v. 5?), libera v. basi coalita; æstivatione imbricata. *Petala* 7–10 v. plura, rarius pauciora, nuda, æstivatione imbricata. *Stamina* ∞ toro interdum incrassato inserta; antheræ lineares, rarius abbreviatæ v. oblongæ, muticæ v. apice connectivo producto, rima longitudinali dehiscentes; filamenta subulata v. capillaria. *Ovarii* placentæ 2–10, ∞-ovulatæ; stylus simplex, stigmate brevissime lobulato v. lobis validioribus adscendentibus v. radiatis, discretis v. peltatim coalitis. *Bacca* coriacea lævis v. sulcata v. undique echinata v. tuberculata, indehiscens v. valvatim dehiscens. *Semina* forma varia; testa crustacea; cotyledones foliaceæ.

Arbores arbusculæ v. frutices in Africa Tropica v. America calidiore crescentes, glabri v. pubescentes, in speciebus paucis spinis axillaribus armati. *Folia* membranacea v. coriacea, alterna, penninervia, serrulata, crenato-serrata, undulata v. integerrima. *Flores* terminales v. axillares, fasciculati v. racemosi, magnitudine varii.

TILIACEARUM genus novum.

Ancistrocarpus*. (§ *Apeibeæ*.)

Sepala 4 libera. *Petala* totidem lata sepala breviora basi nuda. *Stamina* indefinita hypogyna omnia antherifera in phalanges 4 sepalis oppositas coalita, phalangibus basi inter se per membrana connata; antheræ lineares muticæ. *Ovarium* circiter 6-loculare (dissepimentis centro vix coalitis), loculis pluri-ovulatis; stylus simplex elongatus gracilis, stigmate obtuso. *Fructus* globosus coriaceus uncinato-echinatus, poly-

* The genus established by Kunth under this name, rests upon a single species of *Microtea*, to which it has been reduced by Moquin.

spermus; dehiscentia? *Semina* in pulpa nidulantia, matura desunt.—*Frutices* v. arbusculæ. *Folia* alterna glabra v. glabrescentia rigide membranacea denticulata breviter petiolata basi subtripli nervia. *Cymæ* umbelliformes pedunculatæ paucifloræ laterales v. terminales; fructus pedicelli recurvi. *Flores* mediocres, albi.

After dehiscence of the anthers, owing to the posterior cells, which are slightly longer and broader than the anterior, becoming flattened out by the opening of the valves, there appears to be a stout membranous terminal extension of the connective, but this is no true appendage, and I believe that the case is similar in *Apeiba* itself, in some species of which this appearance is very marked.

1. A. DENSISPINOSUS. *Foliis* oblongo-ellipticis v. oblanceolato-oblongis breviter acuminatis acutis denticulatis, ovario breve hirsuto, fructu spinis uncinatis dense echinato.

Hab. Camaroons River, *Mr. Gustav Mann,* 1863 (no. 2204).

Arbuscula 15-pedalis. *Folia* glabra v. nervo medio subter puberula, basi obtusa rotundata v. vix subcordata, $5–8 \times 2\frac{1}{4}$–3-poll. *Petiolus,* primum puberulus 3–4-lin. *Bracteæ* ovato-lanceolatæ squamiformes deciduæ. *Pedicelli* 4–6-lin. *Flores* circ. $1–1\frac{1}{4}$ poll. diametro. *Sepala* linearia extus stellato-pubescentia. *Stylus* stamina superans. *Fructus* in spp. nostris vix maturatus $1–1\frac{1}{4}$ poll. diam., spinis 3–4 lin. longis.

2. A. BREVISPINOSUS. *Foliis* oblanceolato-oblongis breviter acuminatis acutis apicem versus obsolete denticulatis, ovario primum glabro, fructu spinis brevibus distinctis minute uncinatis armato.

Hab. Eppah, on the Niger, *Mr. Barter* (no. 3276).

Frutex. *Folia* basi angustata subcordata v. obtusa, $3\frac{1}{2}–5 \times 1\frac{1}{2}$–2-poll. *Petiolus* 1–3-lin. *Flores* per anthesin non vidi. *Fructus* 1 poll. diam., spinis 1–2 lin. longis.

A single specimen in the Hookerian Herbarium, in fruit only, collected by Mr. Barter in 1857, and described by him as a small tree with long weak branches and showy white flowers belongs to this genus, and may be a third species.

ANONACEARUM genera nova.

1. ENANTIA*.

CHAR. GEN. *Flores* hermaphroditi. *Sepala* tria libera lanceolata, æstivatione valvata. *Petala* exteriora 0. *Petala* interiora (sepalis opposita) tria sepalis multo longiora, crassa, coriacea, ovato-lanceolata v. elliptica, plana v. marginibus

* *Enantia,* Falconer (Hook. Journ. Bot. iv. 75) is a synonym of *Sabia,* Colebr.

leviter reflexis, basi angustiora concava, erecta v. subpatula. *Stamina* indefinita; antheris lineari-oblongis, extrorsis, subsessilibus, connectivo brevi obtusissimo vix dilatato. *Torus* convexus. *Carpella* libera indefinita, dense conferta, ovario piloso; stigma ovario brevius, lineari-oblongum, intus sulcatum, pilosum. *Ovula* solitaria, erecta. *Fructum* non vidi. —Arbor. *Folia* membranacea. *Flores* solitarii breviter pedunculati extra-axillares.

1. E. CHLORANTHA, sp. unica. *Ramuli* pubescentes. *Folia* obovato- v. oblanceolato-oblonga, breviter acuminata, basi cuneata v. vix rotundata, glabra v. nervo medio supra pubescens, 5–10 unc. longa, 2–3½ unc. lata; pet. 1½–3-lin. *Sepala* 6–8 lin. longa, extus strigoso-pilosa, patula v. reflexa. *Petala* 1–1½ unc. longa, 6–8 lin. lata, obtusiuscula, extus minute adpresse pubescentia.

Hab. Old Calabar, *Rev. W. C. Thomson.*

This is the only *Anonacea* known to me in which the outer series of petals is wholly suppressed. Excepting in this particular and in the free ovaries, the flowers resemble those of an *Anona*, in which genus, however, the tendency is to suppression of the inner series of petals. Technically *Enantia* is allied to the tribe Phæantheæ.

2. Cleistochlamys.

Char. Gen. *Flores* hermaphroditi, parvi. *Calyx* æstivatione clausus denique in valvis 2 v. 3 inæqualibus ab apice verticaliter ruptus. *Petala* sex, biseriata, tria exteriora ovata, valvata, tria interiora (alabastro paullo breviora) imbricata. *Stamina* indefinita (circa 30), antheris sessilibus v. subsessilibus, cuneato-quadratis, extrorsis, connectivo apice leviter dilatato truncato. *Torus* convexiusculus. *Carpella* libera 6–8, ovario glabro v. subglabro in stigma breve lineari-oblongum recurvum angustato. *Ovula* solitaria, erecta. *Carpella* maturata oblonga, obtusa, stipitata.—*Frutex* glaber. *Folia* obovato-oblonga v. oblonga, pennivenia. *Flores* parvi, axillares, sessiles.

1. C. Kirkii, sp. unica (Popowia? Kirkii, *Benth. in Linn. Trans.* xxii. 470). Ramosissima, glaberrima. *Folia* obtusa v. acutiuscula basi obtusa, 1½–4 unc. longa, ½–1½ unc. lata; pet. 1–2-lin. *Flores* (in alabastro tantum vidi) 1–1½ lin. diam. *Bracteæ* squamiformes minutæ imbricatæ, rotundatæ. *Calyx* glaber, lævis, tenuiter coriaceus. *Drupæ* 6–8 lin. longæ, 3–4 lin. diam., stipite 2–3-lin.

Hab. Foot of Moramballa; near Tette; near Senna, Zambesi, *Dr. Kirk.*

The fruit, Dr. Kirk states, is edible.

The salient characters of this plant are:—the sepals wholly connate, forming a closed, at length vertically ruptured calyx; the imbricate inner petals (which, with the truncate anthers, place it in the tribe Uvarieæ,) and the very small, usually solitary, axillary, sessile flowers.

I believe Dr. Kirk failed to find any expanded flowers. Our specimens show the first rupturing of the calyx.

Note on the Genera *Darwinia*, Rudge, and *Bartlingia*, Ad. Brongn. By George Bentham, P.L.S.

[Read Feb. 2, 1865.]

Among the Australian plants described and figured by the late Mr. Rudge in the Eleventh Volume of the 'Linnean Transactions,' was a bushy shrub with heath-like leaves, from the neighbourhood of Port Jackson, which he established as a new genus, dedicated, under the name of *Darwinia*, to the author of the Botanic Garden. It belongs to Myrtaceæ, but, owing to Mr. Rudge having overlooked the minute calyx-lobes, and misunderstood some other points of its structure, it was generally referred to Monochlamydeæ, where it naturally did not occur to De Candolle to seek for it when working up the Myrtaceæ for the 'Prodromus.' He makes therefore no mention of that species, nor could he recognize the close affinity borne to it by a plant of which he had specimens from King George's Sound. He therefore described the latter in the 'Prodromus,' and figured it in his memoir on Myrtaceæ as a new genus under the name of *Genetyllis*. Unfortunately he also overlooked the staminodia, expressly distinguishing it from *Chamælaucium* by their absence. Lindley, therefore, in his account of the Swan River vegetation appended to the 'Botanical Register,' having to describe three additional species, where they are present, established another genus under the name of *Hedaroma*, giving to it characters which are really common both to De Candolle's and to Rudge's species, although omitted in their descriptions. Endlicher also, about the same time, in the Second Volume of the 'Annalen des Wiener Museums,' proposed a fourth genus under the name of *Polyzone*, founded chiefly on a peculiarity, at least as strongly marked in De Candolle's original *Genetyllis*. A. Cunningham, in the mean time, in Field's 'New

South Wales,' described a new species from the Blue Mountains, which he correctly referred to Rudge's genus *Darwinia*, but still without recognizing its Myrtaceous affinities, for he placed it under Rhamneæ.

J. C. Schauer, in his elaborate monograph of the tribe Chamælaucieæ of Myrtaceæ, fully established the generic identity of *Hedaroma* and *Polyzone* with *Genetyllis*, and their very close connection with *Darwinia*, but still maintained two genera, enumerating all the western species under *Genetyllis*, and the two eastern ones under *Darwinia*. Since then many new species have been added, amongst them several of great beauty; the heads of flowers enclosed in an involucre of richly-coloured petal-like bracts, which give them a very different aspect from the original Diosma-like plants. These species, three of which have been lately figured in the 'Botanical Magazine,' being all western, have been described under *Genetyllis*. Ferdinand Mueller has also, in his 'Fragmenta Phytographiæ Australiæ,' i. p. 12, reduced to the same genus one which he had previously proposed under the name of *Schuermannia* in the Twenty-fifth Volume of the 'Linnæa,' p. 387; and, from the characters given, it is evidently to *Darwinia fascicularis* that must be referred a plant which F. Mueller formerly described in detail from a specimen cultivated in the Melbourne Botanic Garden, under the name of *Cryptostemon ericæus*. This description was published by Miquel in the 'Nederlandsche Kruidkunde Archiv'; but no specimen appears to have been preserved. We should thus, according to Schauer's views, have one large genus, *Genetyllis*, presenting great diversity in habit and inflorescence, as well as in calyx, staminodia, &c., and another older one, *Darwinia*, of two species only, which are much more closely allied both in habit and in character to corresponding species of *Genetyllis* than they are to each other. Schauer, indeed, in keeping up the two appears to have been much more influenced by geographical than by any other considerations. The characters he gives are at the best theoretical, and, as far as my powers of observation go, purely imaginary. He admits the perfect identity of the two genera in all but the insertion of the staminodia, which indicates, according to him, a difference in the principle of formation or arrangement in the parts of the flower. The staminodia, he says, in *Genetyllis* are equally distant from the sepaline and from the petaline stamens (those opposite the sepals and petals respectively), whilst in *Darwinia* they are nearer to the petaline ones, thus showing that they belong to a different series from those of *Genetyllis*. I have

now carefully examined all the twenty-three species known, most of them from several specimens and in different states, from the young bud to the fully-opened flower, which makes a considerable difference in the apparent arrangement of the stamens. In all I find, as in *Chamælaucium*, *Verticordia*, and other allied genera, the ten stamens and the ten alternating staminodia, when narrow, very shortly dilated at the base, and forming a single ring on the margin of the adnate disk, within the petals, but without any overlapping at the base in the bud. The filaments, as in all Myrtaceæ, are turned down inwards in the bud, and as the anthers, before the flower opens, are too broad to pack in a single row, we always find them alternately in two rows, one more inflexed and consequently lower down and inside the other; and it is always, contrary to what we might theoretically expect, the sepaline stamens (those opposite the calyx-lobes) that are the lowest and innermost, the petaline stamens less inflected and more outside; and the staminodia, still more erect, although usually in the same ring at the base, appear outside of all. Wherever the staminodia are broad, they are even at the base outside of the sepaline or even of both sets of anthers. It follows that they have always a tendency to be nearer the petaline than the sepaline stamens, although in a degree often almost or quite imperceptible, but exceedingly variable in different or sometimes in the same species. This tendency is very perceptible in *Darwinia fascicularis*, Rudge, much more so in *Hedaroma pinifolia*, Lindl. (which Schauer refers to *Genetyllis*, notwithstanding its close resemblance to *D. fascicularis*, and although the broad staminodia are actually outside the sepaline stamens from the base), and, to my eyes at least, imperceptible in *D. taxifolia*, A. Cunn., retained in *Darwinia* by Schauer probably on account of its geographical station. We feel obliged, therefore, to reduce the whole genus *Genetyllis* to *Darwinia*,—a course to be regretted on account of the disturbance of nomenclature it occasions, but Rudge's name has undoubtedly the right of priority; his character was indeed faulty, but so also was De Candolle's, so that neither genus was at first recognized by Lindley or Endlicher.

Ferdinand Mueller has more recently, in the Fourth Volume of his 'Fragmenta,' transferred his group *Schuermannia* to *Chamælaucium*, adding two new and very remarkable species. It appears to me, however, that the anthers afford a much more constant distinctive character between *Darwinia* and *Chamælaucium* than the bracts, and they would certainly place *Schuermannia* in the former not in the latter genus.

For the distinction of species the calyx-petals and staminodia give abundance of constant characters, although, unfortunately, not always sufficiently in accordance with habit or with each other to serve for a systematic distribution of the species. The three groups or sections which I should propose, are founded chiefly upon inflorescence and involucral bracts or floral leaves, accompanied, however, in the case of *Schuermannia* by a marked difference in the calyx-segments.

The following are the species known to me :—

A. HEDAROMA. *Florum* capitula terminalia, sæpius nutantia, bracteis imbricatis coloratis involucrata. *Calycis* lobi minuti v. rarius petalorum dimidium æquantes.

a. *Involucra campanulata v. ovoidea, floribus multo longiora et eos omnino includentia.*

* *Folia sparsa oblonga marginibus recurvis.*

1. D. MACROSTEGIA.—Genetyllis macrostegia, *Turcz. in Bull. Mosc.* 1849, ii. 18; *Kipp. in Journ. Linn. Soc.* i. 51.—Hedaroma tulipifera, *Lindl. in Gard. Chron.* 1854, 323.—Genetyllis tulipifera, *Hook. Bot. Mag.* t. 4858.—W. Australia.

2. D. HOOKERIANA.—Genetyllis macrostegia, *Hook. Bot. Mag.* t. 4860 non Turcz.—G. Hookeriana, *Meissn. in Journ. Linn. Soc.* i. 37.—W. Australia.

3. D. FIMBRIATA.—Genetyllis fimbriata, *Kipp. in Journ. Linn. Soc.* i. 49; *Hook. Bot. Mag.* t. 5468.—W. Australia.

** *Folia opposita parva erecta concava.*

4. D. SPECIOSA.—Genetyllis speciosa, *Meissn. in Journ. Linn. Soc.* i. 36. —W. Australia.

*** *Folia sparsa ericoidea conferta linearia semiteretia v. triquetra.*

5. D. MEISSNERI.—Genetyllis Meissneri, *Kipp. in Journ. Linn. Soc.* i. 49.—W. Australia.

6. D. HELICHRYSOIDES.—Genetyllis helichrysoides, *Meissn. in Journ. Linn. Soc.* i. 37.—W. Australia.

7. D. ŒDEROIDES.—Genetyllis œderoides, *Turcz. in Bull. Mosc.* 1849, ii. 18.—W. Australia.

b. *Involucra patentia flores vix excedentia, v. eis breviora.*

* *Folia sparsa conferta. Capitula multiflora.*

8. D. VIRESCENS.—G. virescens, *Meissn. in Journ. Linn. Soc.* i. 38.— W. Australia.

9. D. Oldfieldii, sp. n. Foliis sparsis confertis parvis oblongis marginibus recurvis ciliatis, involucri bracteis ovatis ciliatis imbricatis squarrosis flores non excedentibus, bracteolis abbreviatis, calycis tubo medio 2–3-annulato, staminodiis lanceolatis.—D. purpureæ affinis, differt foliis bracteisque ciliatis, bracteolis brevibus latis, floribus majoribus, calyce annulis papillosis 2–3 nec 5–6 cincto, et staminodiis lanceolatis nec subulatis.—W. Australia, Murchison River, *Oldfield.*

10. D. purpurea.—Polyzone purpurea, *Endl. in Ann. Wien. Mus.* ii. 191; Genetyllis purpurea, *J. C. Schauer, Myrt. Xeroc.* 27. t. 2 b.—W. Australia.

** *Folia opposita, oblonga. Capitula 4-flora.*

11. D. citriodora.—Genetyllis citriodora, *Endl. in Hueg. Enum.* 47, *J. C. Schauer, Myrt. Xeroc.* 31. t. 2 c; Hedaroma latifolium, *Lindl. Swan River App.* 7. t. 2 b; Genetyllis pimeleoides, *F. Lindl. Fragm.* ii. 169.—W. Australia.

B. Genetyllis. *Flores* in capitula terminalia dispositi v. in axillis superioribus solitarii, foliis floraliis caulinis subsimilibus. *Calycis* lobi minuti v. vix dimidium petalorum æquantes.

* *Folia pleraque opposita linearia lanceolata falcatave. Caulis diffusus v. decumbens.*

12. D. thymoides.—Hedaroma thymoides, *Lindl. Swan River App.* 7; Genetyllis thymoides, *J. C. Schauer, Myrt. Xeroc.* 33; Darwinia brevistyla, *Turcz. in Bull. Mosc.* 1847, i. 155.—W. Australia.

13. D. taxifolia, *A. Cunn. in Field. N. S. Wales*, 352.—D. laxifolia, *J. C. Schau. Myrt. Xeroc.* 38.—N. S. Wales.

** *Folia sparsa parva subimbricata obovata v. oblonga. Frutices erecti. Flores distincte pedicellati.*

14. D. vestita.—Genetyllis vestita, *Endl. in Hueg. Enum.* 47.—W. Australia.

15. D. pauciflora, sp. n.—D. vestitæ affinis, sed flores majores in capitulo pauciores (sæpius 4), mox gemma centrali evoluto infra apicem ramuli axillares, calyce late turbinato nec anguste campanulato.—W. Australia, S. Hutt River, *Oldfield.*

*** *Folia sparsa ericoidea linearia semiteretia v. triquetra. Frutices erecti. Flores subsessiles.*

16. D. diosmoides.—Genetyllis diosmoides, *DC. Prod.* iii. 209, et *Mem. Myrt.* t. 2; *J. C. Schau. Myrt. Xeroc.* 28. t. 2 a.—D. Drummondii, *Turcz. in Bull. Mosc.* 1847. i. 155.—W. Australia.

17. D. FASCICULARIS, *Rudge in Trans. Linn. Soc.* xi. 299. t. 22; *J. C. Schau. Myrt. Xeroc.* 36. t. 2 D.—Cryptostemon ericæus, *F. Muell. ex Miq. in Nederl. Kruidk. Arch.* iv. 115.—N. S. Wales.

C. SCHUERMANNIA. *Flores* in capitula terminalia dispositi v. in axillis superioribus solitarii, foliis floralibus caulinis subsimilibus v. paucis coloratis flore brevioribus. *Calycis* lobi petaloidei petala æquantes v. subsuperantes.

* *Flores dense capitati receptaculo indiviso impositi.*

18. D. PINIFOLIA.—Hedaroma pinifolium, *Lindl. Swan River App.* 7.—Genetyllis pinifolia, *J. C. Schau. Myrt. Xeroc.* 34.—W. Australia.

** *Flores capitati, capitulo composito denso.*

19. D. SANGUINEA.—Genetyllis sanguinea, *Meissn. in Journ. Linn. Soc.* i. 38.—W. Australia.

20. D. MICROPETALA.—Genetyllis micropetala, *F. Muell. Fragm.* i. 12.—S. Australia.

*** *Flores in axillis superioribus solitarii.*

21. D. SCHUERMANNI.—Schuermannia homoranthoides, *F. Muell. in Linnæa*, xxv. 387.—Genetyllis Schuermanni, *F. Muell. Fragm.* i. 12.—S. Australia.

22. D. VERTICORDINA.—Chamælaucium verticordinum, *F. Muell. Fragm.* iv. 37.—W. Australia.

23. D. THOMASII.—Chamælaucium Thomasii, *F. Muell. Fragm.* iv. 137. t. 30.—Queensland.

How the genus *Bartlingia* came to be retained in Chamælaucieæ in so elaborate a monograph as that of J. C. Schauer appears to me inexplicable. It was originally founded by Adolphe Brongniart, who, in preparing his memoir on Rhamneæ published in the Tenth Volume of the First Series of the 'Annales des Sciences Naturelles,' met with some specimens of Sieber's from New South Wales in very young bud only, and distributed under the name of *Cryptandra obovata*; Brongniart readily ascertained that they could not belong to Rhamneæ, and described them as a new genus, which, under the name of *Bartlingia*, he was disposed to refer to Rosaceæ near Amygdaleæ and Chrysobalaneæ; Reichenbach, afterwards, in the lists of genera in his 'Conspectus Regni Vegetabilis,' p. 176, first transferred it to Myrtaceæ, but apparently without further examination. Schauer, however, after a detailed analysis, confirms this as its true affinity, notwithstanding

its prominent persistent stipules, nearly hypogynous stamens, and free monocarpic ovary, all unknown in Myrtaceæ. The Sieberian specimens in the Hookerian herbarium are in the same state as those examined by Ad. Brongniart, and by J. C. Schauer; and on a careful analysis I find the description and figure of the latter author (Myrt. Xerocarp. p. 22. t. 1. A.) perfectly correct, except as to the position of the ovules, about which he admits having some doubts; but I also find that the plant is no other than *Pultenæa obovata* described in my 'Flora Australiensis,' ii. p. 123, the buds in Sieber's specimens being in that very young stage when the sepals and petals have not yet grown out into those irregularities characteristic of Papilionaceœ. On re-examining the specimens on which I had founded the *P. obovata*, I found a few buds scarcely further advanced than those of Sieber's with the petals still small, scale-like, and nearly equal; I also found that the bicarpellary flowers noticed in my Flora are, as I supposed, not universal in the species, although prevalent in the particular specimens first examined.

Notice of some Vegetable Monstrosities. By George Dickie, A.M., M.D., F.L.S., Prof. Bot. University of Aberdeen.

[Read Feb. 16, 1865.]

Departures from the ordinary structure of the organs in plants have been frequently recorded; it is unnecessary, however, to apologize for adding to the number of such records, when it is considered that from an accumulation of these, valuable aid is derived in relation to morphology.

Cheiranthus cheiri.

Transformation of stamens into pistils has been described in plants belonging to different natural orders; in these the deviations have been either partial or complete; in the former case the filament retained its usual appearance, the anthers alone resembling a pistil and bearing ovules, in other instances the filaments had the structure of ovaries and the anthers changed so as to resemble stigmas*.

* For a summary of such, see Moquin-Tandon, Teratologie Végétale, pp. 222 & 223.

The Common Wallflower was long since observed by Mr. Brown as sometimes showing the change in question. An example having come under notice some time ago, a brief account, illustrated by specimens, may be worthy of record. The plant had attained considerable size, a large bush in fact, and the perianth had dropped in all excepting a few flowers, in these the two outer whorls appeared to be quite natural. The six stamens were entirely changed into a compound ovary, the edges of each piece entirely adherent and concealing the ordinary seed-vessel; in advanced stages this body gave way at the apex, opening on two sides, between the parts representing the long stamens, thus allowing the true ovary to protrude. The change in the staminal whorl may be shortly described as follows:—the place of the stamens was occupied by a body resembling an oblong capsule of six valves, adherent together, the edges infolded; these six pieces being easily separable, four of them evidently corresponded to the four long stamens, and two to the shorter; the latter pieces were more convex than the others, their stigmas shorter, and they were placed on opposite sides of the axis. Each had two rows of ovules attached to the infolded margins, and the whole might be compared to the capsule of a poppy having twelve rows of ovules on as many projecting parietal placentæ. The ovules examined were composed apparently of a uniform mass of cellular tissue, corresponding probably to nucleus, and each supported by a cord several times longer than the ovule. In some cases this singular ovary attained considerable size, entirely concealing the true ovary, in others it appeared to stop at an early stage, the proper seed-vessel projecting considerably beyond it; there was, in fact, an inverse relation in their respective lengths. This enlargement of the normal ovary was of course independent of fecundation; on examination it was found generally to have the ordinary structure, the ovules having, however, the same characters as those of the abnormal ovary; in others, the *replum* was absent, and from the base, and apparently continuous with the axis, there grew another ovary, much smaller and more like a leaf.

Plantago major.

I have had in cultivation for some time, a form of this common plant which has the following peculiarities:—The entire plant is far more luxuriant than usual, most of the bracts are large, in some the length is about 4 inches, in them the spike is usually very much shortened, and most of the flowers abortive, but in

others the spike has the usual form, and many of the flowers produce apparently perfect seeds, usually the relation between development of flowers and that of bracts is inverse. From the axil of some of these enlarged bracts there grows a peduncle supporting a spike, which is nearer the natural structure as to length, size of bracts, and development of flowers.

TRIFOLIUM HYBRIDUM.

This plant, known as a forage plant by the name Alsike Clover, sometimes shows complete transformation of its ovary into a leaf resembling in miniature the ordinary leaves of the plant. Sometimes the change is incomplete, the leaf remaining conduplicate, with edges partially adherent near the apex, with a gradual prolongation resembling style and stigma.

Notes on Lichens collected by Sir JOHN RICHARDSON in Arctic America. By the Rev. W. A. LEIGHTON, B.A., F.B.S.E. Communicated by Dr. HOOKER, F.R.S., V.P.L.S.

[Read March 16, 1865.]

[PLATE II.]

AT the request of Dr. Joseph D. Hooker, of Kew, I have undertaken to examine and name a large case of Lichens collected by Sir J. Richardson in Arctic America, chiefly in 1826, and the following descriptive Catalogue is the result of the examination.

The localities whence the Lichens were collected were Mackenzie River (lat. 67° N.); Great Bear Lake (lat. 66° N.); Fort Franklin (lat. 65° 14′ N.); Fort Enterprise (lat. 64° 33′ N.); Great Slave Lake (lat. 61° 30′ N.); York Factory, Hudson's Bay (lat. 57° N.); Missinnippi River (lat. 55° 40′ N.); and River St. Mary's, Lake Superior (lat. 47° N.).

The number of Lichens which I have named is 163, including species, varieties, and forms. Only two Lichens, *Platysma Richardsonii* and *Dactylina arctica* peculiar to North America were found in the collection; unless the species which I have hereafter described as new, *Verrucaria Frankliniana*, *Arthonia intumescens*, and *Odontotrema Richardsonii* are to be added, but whose distribution is at present necessarily doubtful. The remainder were common to Scandinavia and Europe generally.

They may be tabulated thus:—

	Genera.	Species.	Varieties or Forms.
Nostochinei	1	1	0
Collemei	2	3	0
Caliciei	1	1	0
Bæomycei	1	1	0
Cladoniei	1	14	49
Stereocaulei	1	1	0
Siphulei	1	1	0
Usneei	5	8	8
Cetrariei	2	7	8
Peltigerei	3	8	1
Parmeliei	3	13	10
Gyrophorei	1	5	2
Lecanorei	7	23	9
Lecideini	2	15	8
Graphidei	3	3	0
Pyrenocarpei	1	4	0
Total	35	108	95

Sir John Richardson has kindly communicated some information respecting the formation of the collection, which, with his permission, I here insert.

"During our summer travelling, that is from the end of June till the end of August, no lichens were gathered. We seldom landed from the boats oftener than twice a day, and stayed on shore only half an hour at a time, or until our kettle was boiled. This time was spent in the collection of phænogamous plants; the immediate banks of the rivers, or at least the spots where landing was convenient, being unproductive of lichens, being either rocks smoothly shaven by the ice borne over them in the spring floods, or thickets of young willows. In the winter-time the terrestrial lichens were deep under the snow till late in June, and the forests near our winter-houses being of white spruce, yielded no variety of corticolar lichens. On the boat-tracks, frequent fires had consumed the old forest trees, and we had no leisure to explore the depths of the woods. A few corticolar lichens were got on Lake Superior, where the trees are more various. The terrestrial lichens were gathered at Great Bear and Great Slave Lakes before starting on our summer voyages after the snow had melted; and, from my ignorance of the species of *Cladonia*, I preserved more specimens than I would otherwise have done, and most likely neglected some that I ought to have taken. The Barren Grounds are densely covered for many hundreds of miles with

Corniculariæ and Cetrariæ, and where the ground is moist with Cladoniæ, while the boulders thickly scattered over the surface are clothed with Gyrophoræ; but the number of specimens of each species in my collection will be no measure of the existing number of plants in any locality. The smaller stones on the gravelly ridges of the Barren Grounds are covered with lichens; but as they could not be detached and we could not carry the stones with us, few were gathered. What I did bring home were obtained in 1822–23 near Fort Enterprise, and they are named by Sir William Hooker in the Botanical Appendix to Franklin's first journey, 4to edition, 1823."

Valuable and interesting as the collection assuredly is, still, as the foregoing account shows that it professes to be neither complete nor comprehensive, it would seem to be mere guess-work to attempt to speculate on the distribution of the lichens further than is done in the preceding table.

Three perfect sets of the lichens have been made up; one for the National Herbarium at Kew; one for Sir John Richardson; and one for my own herbarium. The numbers prefixed to the names in the Catalogue correspond with similar numbers on the specimens themselves, and will serve as a guide to future identification.

Nostoc.

No. 1. N. commune, *Vauch.*

For the connection between *Nostoc* and *Collema* see 'Microscopical Journal,' vol. i. (new ser.) pp. 13 & 90, and vol. viii. p. 239.

Leptogium, *Fr.*

No. 2. L. tremelloides, *Fr.*

Hab. Great Bear Lake.

Without fructification.

No. 3. L. saturninum, *Nyl.*

Hab. Great Slave Lake; Great Bear Lake.

Without fructification.

No. 4. [N.B. There was another single specimen from Great Slave Lake which possibly may be *Collema pulposum*, Ach., but in too imperfect a condition to decide.]

Coniocybe, *Ach.*

No. 5. C. furfuracea, *Ach.*

Hab. On decaying moss and branches by a rivulet in a shady place, Bear Lake, Nov. 10, 1825.

Bœomyces, *Pers.*

No. 6. B. icmadophilus, *Nyl.*; *Fellmann's Lich. Lapp. Orient.* 24.
Hab. Fort Franklin; Great Bear Lake.

Cladonia, *Hoffm.*

C. pyxidata, *Fr.*
No. 7. Forma *simplex*, Ach.
Hab. Great Slave Lake; Great Bear Lake.

No. 8. Forma *staphylea*, Ach.
Hab. Great Bear Lake.

No. 9. Forma *simplex*, Ach. Transiens in *C. pityream*, Ach.=forma *pocillum*, Ach. "podetia per ætatem versus marginem scyphi pulverulenta evadunt."
Hab. Great Bear Lake.

No. 10. C. cariosa, Flk. *Nyl. Syn.* 194; *Fellmann's Lich. Lapp. Orient.* 27.
Hab. Great Slave Lake; Great Bear Lake; Fort Franklin.

C. fimbriata, *Hoffm.*
No. 11. Forma *conista*, Ach.
F. *tubæformis*, Ach. (the only specimen).
Hab. Great Bear Lake.

No. 12. C. pityrea, *Ach.*
Forma *simplex* accedens ad formam *denticulatam*.
Hab. Great Bear Lake.

[From careful observation of the living plants, and of extensive series in my herbarium, it appears to me that there are two intermediate series (species?) between *C. pyxidata* and *fimbriata*. They may be thus distinguished:—

C. pyxidata, *Fr.* Podetia continuously corticate, granulato-verrucose.
Forma *simplex*. Scyphi cup-shaped, short, simple.
F. *staphylea*. Apothecia on the margin of the scyphi podicillate, large.
F. *syntheta*. Scyphi simply or repetito-proliferous.
F. *lophyra*. Scyphi foliaceo-crisped on the margin and prolificant.
F. *pocillum*. Thalline leaves broad and thick; podetia and diaphragm verrucose albo-cæsious, pruinose (transitus in *pityream*).

C. pityrea, *Ach.* Podetia pulverulento-granuloso-furfuraceous, ashy white, smooth and decorticate in the upper part.
Forma *simplex*. Scyphi simple.
F. *denticulata*. Margins of scyphi denticulate.
F. *syntheta*. Scyphi simply or repetito-proliferous.

F. *decorticata.* Podetia elongated, cylindrical, white, decorticate, squamoso-exasperate (transitus in *cariosam*).

C. CHLOROPHÆA, *Flk.* Podetia pulverulent, granules coarser at the base, sulphury-yellow (transitus in *fimbriatam*).

C. FIMBRIATA, *Hoffm.* Podetia elongate, cylindrical, clothed entirely with a very *fine white dust.*

Forma *conista.* Podetia short, subturbinate, scyphi cyathiform, simple; margin entire.

F. *tubæformis.* Podetia elongate, cylindrical; scyphi regular; margins entire.

F. *denticulata,* similar to *tubæformis* in shape, but margins of scyphi denticulate.

F. *carpophora.* Similar to *tubæformis* in shape, but margins of scyphi bearing apothecia.

F. *fibula.* Podetia long, subcylindrical; scyphi narrow or none; apothecia sessile, congested.

F. *abortiva.* Podetia elongated obtuse, or obscurely scyphiferous, more or less squamose.

F. *prolifera.* Scyphi proliferous.

F. *radiata.* Podetia elongated; margins of scyphi more or less variously radiate.

F. *cornuta.* Podetia elongated, subuliform, simple or branched.

F. *nemoxyna.* Podetia long, branched, branches divided, subuliform.]

C. GRACILIS, *Hoffm.*

No. 13. Forma *subulata,* Dill. xiv. fig. 13 c (*gracilis,* Ach. Syn.).
Hab. Great Bear Lake.

No. 14. Forma podetiis ascyphis et scyphis simplicibus.
Hab. Great Bear Lake.

No. 15. Forma scyphis simplicibus.
Hab. Great Bear Lake; Great Slave Lake.

No. 16. Forma scyphis proliferis.
Hab. Great Bear Lake.

No. 17. Forma podetiis basi infuscatis.
Hab. Great Bear Lake.

C. CORNUTA, *Fr.*

No. 18. Formæ *subulata, scyphophora,* et *radiata.*
Hab. Great Bear Lake.

C. DEGENERANS, *Flk.*

No. 19. Forma *haplotea,* Ach. (Nyl. Syn. 200).
Hab. Great Bear Lake.

No. 20. Forma *euphorea,* Ach. (Nyl.). "Podetiis efoliolosis vix vel obsolete albo-punctatis." Vergens ad *Cl. gracilem.*
Hab. Great Bear Lake.

No. 21. Forma proxime accedens ad *C. gracilem*.
Hab. Great Bear Lake.

No. 22. Forma *pleolepis*, Ach. Podetiis foliaceo-squamulosis; apotheciis et squamulis densissime confertis super scyphos.
Hab. Great Bear Lake.

No. 23. Forma *anomæa*, Ach.
Hab. Great Bear Lake.

No. 24. Forma *lepidota*, Ach.
Hab. On Twigs, York Factory.

No. 25. Forma *cladophora*, Leighton. Podetiis prolificatione scyphorum evanescentium subdichotomo-ramosis sursum attenuatis, scabridis aut verruculosis, fusco-cinereis, basi albo-guttatis, apicibus denticulatis; apotheciis minutis fuscis.
Hab. Great Bear Lake.

C. FURCATA, *Hoffm.*

No. 26. Forma *recurva*.
Hab. Great Bear Lake.

C. CRISPATA (*Ach.*), *Nyl.*

No. 27. Identical with Tuck. Lich. Amer. Sept. 31.
Hab. Great Slave Lake.

No. 28. Forma podetiis superne dilatatis; scyphis prolifero-ramosissimis cymosis.
Hab. Great Slave Lake; Great Bear Lake.

No. 29. Forma *C. fascicularis β. albicans*, Del. in Dub. Bot. Gall. 627.
Hab. Great Bear Lake.

C. RANGIFERINA, *Hoffm.*

No. 30. Forma typica, apicibus subsecundis nutantibus.—Dill. xvi. f. 29 A.
Hab. Great Slave Lake.

No. 31. Forma *gigantea*, Ach. Podetiis subverruculosis.
Hab. Great Bear Lake.

No. 32. Forma *cymosa*, Ach. Syn. Apicibus divergentibus cymosis.
Hab. Great Bear Lake.

No. 33. Forma *sylvatica*, Ach. Apicibus erectiusculis vix nutantibus.—Dill. xvi. fig. 30 B.
Hab. Great Bear Lake.

No. 34. Var. *alpestris*, Ach. Apicibus densissime thyrsoideis; podetiis albido-stramineis.—Dill. xvi. fig. 29 E, F; Fellm. Lich. Lapp. Or. 39.
Hab. Great Bear Lake.

No. 35. Forma *pumila*, Ach. Syn. Densissime cæspitosa.
Hab. Great Bear Lake.

C. AMAUROCRÆA, *Flk.*

No. 36. Forma ascypha minor.
Hab. Great Bear Lake.

No. 37. Forma ascypha excelsior.
Hab. Great Bear Lake.

No. 38. Forma scyphis angustis sterilibus.—Fries, L. S. 347.
Hab. Great Bear Lake; Great Slave Lake.

No. 39. Forma ascypha; axillis dilacerato- aut digitato-cristatis.
Hab. Great Bear Lake.

No. 40. Forma ascypha; axillis ramosissime cristatis.—Fellm. Lich. Lapp. Or. 41.
Hab. Great Bear Lake.

No. 41. Forma scyphifera, sterilis; axillis digitato-cristatis.
Hab. Great Bear Lake.

No. 42. Forma scyphifera, humilior; axillis ramosissime cristatis.
Hab. Great Bear Lake.

No. 43. Forma scyphifera, excelsior; axillis ramosissime cristatis.
Hab. Great Bear Lake.

No. 44. Forma humilior; podetiis fertilibus; axillis digitato- aut dilacerato-cristatis.
Hab. Great Bear Lake.

No. 45. Forma excelsior; podetiis fertilibus; axillis digitato- aut dilacerato-cristatis.
Hab. Great Bear Lake.

No. 46. Forma podetiis fertilibus; axillis ramosissime cristatis.
Hab. Great Bear Lake.

C. CORNUCOPIOIDES, *Fr.*

No. 47. Forma *stemmatina,* Ach. L. U.
Hab. Great Bear Lake.

No. 48. Forma *expansa,* Nyl. Syn. 220.
Hab. Great Bear Lake.

No. 49. Forma *extensa,* Ach. L. U. Vaill. Par. xxi. fig. 4.
Hab. Great Bear Lake.

C. DEFORMIS, *Hoffm.*

No. 50. Forma *pulvinata,* Ach. L. U. Ætate juniore.
Hab. Great Bear Lake.

No. 51. Forma *pulvinata,* Ach. L. U. Ætate majore.
Hab. Great Bear Lake.

No. 52. Forma sub scypho leviter angustata.
Hab. Great Bear Lake.

No. 53. Forma *gonecha*, Ach. L. U. Podetiis sursum sensim incrassata.
Hab. Great Bear Lake.

No. 54. Forma podetiis proliferis.
Hab. Great Bear Lake.

No. 55. C. UNCIALIS, *Hoffm.*, var. dilacerata, *Leight.*
Hab. Only 4 specimens, 2 from Great Slave Lake; 2 from Great Bear Lake.

This is a very remarkable plant, resembling *uncialis* in form of podetia and colour, but having the lower portion of the podetia split up into long narrow strips, somewhat crenate at the margins, and thus at first sight appearing as large thallodal leaves; but careful examination shows the true structure.

STEREOCAULON, *Schreb.*

No. 56. S. TOMENTOSUM, *Fr.*; *Tuck. L. Am. Sept.* 23.
Hab. Great Bear Lake.

THAMNOLIA, *Ach.*

No. 57. T. VERMICULARIS, *Ach.* The *taurica* form intermixed.
Hab. Mackenzie's River; Great Bear Lake. (See *T. M. Fries, Lichenes Arctoi*, p. 161, and *Massalongo, de Thamnolia, in Flora*, 1856, no. 15.)

USNEA, *Hoffm.*

No. 58. U. BARBATA, *Fr.*
Forma *hirta* elongata.
Hab. Great Slave Lake.

No. 59. U. BARBATA, *Fr.*
Forma *plicata*, Fr.
Hab. Great Slave Lake.

No. 60. U. BARBATA, *Fr.*
Forma *ceratina*, Schær.
Hab. Great Slave Lake.

No. 61. U. LACUNOSA, *Willd.* (*Nyl. Syn.* 271).
Hab. Great Slave Lake.

ALECTORIA, *Ach. Nyl.*

No. 62. A. JUBATA, *Ach.*
Forma *prolixa*, Ach.
Hab. Great Bear Lake.

No. 63. A. JUBATA, *Ach.*
Forma *chalybeiformis*, Ach.
Hab. Great Bear Lake.

No. 64. A. DIVERGENS, *Nyl.*
Hab. Great Bear Lake.

No. 65. A. OCHROLEUCA, *Nyl.*
Var. nigricans, *Fellm. Lich. Lapp. Or.* 52.
Hab. Great Bear Lake.

EVERNIA, *Ach. & Nyl.*

No. 66. E. PRUNASTRI, *Ach.*
Forma thallo albido-flavescente sparsim albo-sorediooso.
Hab. Great Slave Lake; Great Bear Lake; York Factory, Hudson's Bay.

DACTYLINA, *Nyl.*

No. 67. D. ARCTICA, *Nyl.*
Hab. Great Bear Lake; Great Slave Lake.

Dr. Nylander mentions, in his 'Syn.' p. 286, that he had not seen the spermogonia, which, however, I detected on the apices and sides of some few of these specimens. They appeared as black specks on slight prominences, internally colourless.

PLATE II.

Fig. 11. Spermogonia nat. size.
Fig. 12. Spermogonium magnified.
Fig. 13. Vertical section of spermogonium.
Fig. 14. Ascus.
Fig. 15. Spores, magn. 1200 lin.
Fig. 16. Sterigmata.
Fig. 17. Spermatia *.

RAMALINA, *Ach. Fr.*

No. 68. R. CALICARIS, *Fr.*
Forma farinacea (*Fr.*). Minute specimens.
Hab. Great Slave Lake.

CETRARIA, *Ach. & Nyl.*

No. 69. C. ISLANDICA, *Ach.*
Forma *platyna,* Ach.
Hab. Great Bear Lake.

No. 70. Forma *tubulosa,* Schær. Fruit.
Hab. Great Bear Lake.

No. 71. Forma *Delisei,* Schær; Fell. Lich. Lapp. Or. 60.
Hab. Great Bear Lake.

Only a single specimen.

No. 72. Forma *crispa,* Ach.; Fell. Lich. Lapp. Or. 59, Fruit.
Hab. Great Bear Lake; Great Slave Lake.

* Since writing the above, I find that Dr. W. L. Lindsay had described and figured the sterigmata and spermatia in his elaborate Essay on the Spermogones and Pycnides in Trans. Edin. Roy. Soc. vol. xxii. part i. (1859) p. 133 and tab. vi. f. 23, for which he so deservedly obtained the Neill Gold Medal.

Platysma, *Hoffm. Nyl.*

No. 73. P. nivale, *Nyl.*
Hab. Great Slave Lake.

In fine fructification. Some of the specimens had the thallus of a more intense yellow colour (= *Cetraria Tilesii*, Ach. Syn. 228).

No. 74. P. cucullatum, *Hoffm.*
Hab. Great Bear Lake.

In fine fructification.

No. 75. A form apparently intermediate between *nivale* and *cucullatum*, with scrobiculate thallus but sporidia of *cucullatum*.
Hab. Great Bear Lake.

In fructification.

No. 76. P. juniperinum, *Nyl.*
Var. *terrestris*, Schær. L. H. 20.
Hab. Mackenzie's River; Great Bear Lake.

Not in fructification.

No. 77. P. juniperinum, *Nyl.*
Var. *pinastri*, Ach.
Hab. Great Slave Lake; York Factory, Hudson's Bay.

Not in fructification.

No. 78. P. sæpincola, *Hoffm., Schær. L. H.* 297.
Hab. Great Bear Lake; Great Slave Lake; York Factory, Hudson's Bay.

No. 79. P. Richardsonii (*Hook*).
Hab. Great Bear Lake.

No. 80. P. lacunosum, *Nyl.*
Forma *atlantica*, Tuck. L. Am., Sept. 6.
Hab. Great Slave Lake.

Nephromium, *Nyl.*

No. 81. N. tomentosum, *Nyl.*; *Tuck. L. Am. Sept.* 13; *Schær. L. H.* 259.
Hab. Missinnippi or English River; Great Bear Lake.

No. 82. N. tomentosum, *Nyl.*
Var. *helveticum*, Nyl.; Tuck. L. Am. Sept. 14; Schær. L. H. 260.
Hab. Missinnippi or English River.

Peltigera, *Hoffm.*

No. 83. P. aphthosa, *Hoffm.*
Hab. Great Bear Lake.

No. 84. P. CANINA, *Hoffm.*
Hab. Great Slave Lake.

No. 85. P. RUFESCENS, *Hoffm.*
Hab. Great Bear Lake; Great Slave Lake.

No. 86. P. SPURIA, *DC.*
Hab. Great Slave Lake.

No. 87. P. VENOSA, *Hoffm.*
Hab. Great Bear Lake.

SOLORINA, *Ach.*

No. 88. S. SACCATA, *Ach.*
Hab. Great Bear Lake; Great Slave Lake.

No. 89. S. LIMBATA (*Sommrf.*).
Lichen spongiosus, *E. Bot.* t. 1374.—S. saccata, var. spongiosa, *Nyl. Syn.* 331.—S. limbata, *Mudd. Man.* 85.—Lecanora limbata, *Sommrf. Suppl. Fl. Lapp.* 105. tab. 3. figs. 1–9.
Hab. Great Bear Lake.

The 'English Botany' figure gives a fair general representation of this plant, especially of the cupular margined apothecia. Dr. Nylander, in his 'Synopsis,' considers it only as a variety of *S. saccata.* It seems something very nearly approaching to presumption to differ from so learned and accurate a botanist as Dr. W. Nylander, the *facile princeps* of European lichenologists; but the different shape and size of the sporidia, added to the other peculiarities of the plant impel me to regard it as distinct.

PLATE II.

Fig. 8. Spore of *S. saccata*, mag. 1200 lin.
Fig. 9. Spores of *S. limbata*, magn. 1200 lin.
Fig. 10. Ascus of the same, magn. 330 lin.

RICASOLIA, *D. N. Nyl.*

No. 90. R. HERBACEA, *D. N. Fries, L. S.* 334.
Hab. Great Slave Lake.

PARMELIA, *Ach. Nyl.*

No. 91. P. SAXATILIS, *Ach.*
Hab. Fort Franklin; Great Bear Lake.

No. 92. P. OLIVACEA, *Ach.*
Hab. Great Bear Lake; Great Slave Lake; York Factory, Hudson's Bay.

No. 93. P. STYGIA, *Ach.*
Hab. Fort Enterprise.

No. 94. P. LANATA, *Nyl.*
Hab. Great Bear Lake.

No. 162. P. LANATA, *Nyl.*
Forma minuscula, *Fellm. Lich. Lapp. Or.* 83.
Hab. Fort Enterprise.

No. 95. P. PHYSODES, *Ach.*
Var. *vittata,* Ach.
Hab. Great Bear Lake.

No. 96. P. PHYSODES, *Ach.*
Forma *platyphylla,* Ach.
Hab. Great Bear Lake.

No. 97. P. PHYSODES, *Ach.*
Forma *obscurata,* Ach.
Hab. Great Bear Lake.

No. 98. P. PHYSODES, *Ach.*
Forma *placorhodioides,* Nyl.?
Hab. Great Bear Lake.

PHYSCIA, *Nyl.*

No. 99. P. PARIETINA (*L.*).
Var. *lychnea* (Ach.).
Hab. Fort Enterprise.

No. 100. P. CANDELARIA (*Ach.*). Non fertilis.
Hab. Great Slave Lake.

No. 101. P. CILIARIS, *DC.*
Forma crinalis, margine receptaculi fimbriato.
Hab. Great Bear Lake; Great Slave Lake.

No. 102. P. PULVERULENTA, *Fr.*
Hab. Mackenzie's River.

No. 103. P. STELLARIS, *Fr.*
Var. *leptalea* (Ach.).
Hab. Great Slave Lake.

No. 104. P. CÆSIA, *Fr.*
Hab. Great Bear Lake.

No. 105. P. OBSCURA, *Fr.*
Var. *muscicola,* Schær. Enum. p. 37.
Hab. Great Bear Lake.

No. 106. P. OBSCURA, *Fr.*
Var. *cycloselis,* forma *saxicola.*
Hab. Great Bear Lake.

UMBILICARIA, *Hoffm.*

No. 107. U. PUSTULATA, *Hoffm.*
Hab. Great Slave Lake.

No. 108. U. VELLEA (*Ach.*); *Nyl. L. Scand.* 114.
Hab. Great Slave Lake.

No. 109. U. CYLINDRICA (*L.*).
Var. *Delisei,* Nyl. L. Scand. 117. Thallo subtus fibrillis rhizineis.
Hab. Great Slave Lake.

No. 110. U. EROSA, *Hoffm.*
Forma thallo subtus granulato efibrilloso.
Hab. Great Slave Lake; Great Bear Lake.

No. 111. U. MUHLENBERGII (*Ach.*); *Tuck. Syn. L. Am. Sept.* 74.
Hab. Great Slave Lake.

PSOROMA, *Fr. Nyl.*

No. 112. P. HYPNORUM, *Fr.*
Hab. Great Bear Lake.

PANNARIA, *Del. Nyl.*

No. 113. P. BRUNNEA, *Mass.*
Hab. Mackenzie River; Great Bear Lake.

No. 114. P. MUSCORUM (*Ach.*).
Hab. Great Bear Lake.

SQUAMARIA, *DC.*

No. 115. S. CHRYSOLEUCA (*Sm.*).
Hab. Fort Enterprise.

No. 116. S. SAXICOLA (*Ach.*).
Hab. Fort Enterprise.

No. 117. S. AMBIGUA (*Wulf.*).
Hab. Fort Franklin; Great Bear Lake; Great Slave Lake.

PLACODIUM, *DC. Nyl.*

No. 118. P. ELEGANS, *DC.*
Hab. Great Bear Lake; Great Slave Lake; Fort Enterprise.

LECANORA, *Ach. Nyl.*

No. 119. L. CERINA, *Ach.*
Forma *pyracea,* Ach.
Hab. Great Slave Lake.

No. 120. L. CERVINA, *Ach.*
Var. *smaragdula*, Schær.
Hab. Fort Enterprise.

No. 121. L. CERVINA, *Ach.*
Var. *glaucocarpa*, Schær.
Hab. Fort Enterprise; Great Bear Lake.

No. 122. L. FULVO-LUTEA, *Nyl. Scand.* 146.
Lecidea fusco-lutea, *Schær*! *Enum.* 147 (non L. fusco-luteus, *Dicks.*!); *Fellm. Lich. Lapp. Or.* 110.
Hab. Fort Franklin; Great Bear Lake.

PLATE II.

Fig. 4. Spores of *L. fulvo-lutea*, magn. 1200 lin.
Fig. 5. Spores of *L. fusco-luteus*, Dicks., magn. 660 lin.

No. 123. L. VITELLINA, *Ach.*
Var. *aurella*, Ach.
Hab. Fort Franklin.

No. 124. L. CINEREA (*L.*).
Var. *alpina*, Zwachk, 4.
Hab. Fort Enterprise.

No. 125. L. PARELLA, *Ach.*
Var. *Upsaliensis* (L.).
Hab. Mackenzie River.

No. 126. L. ALBELLA (*Pers.*).
Hab. River St. Mary's, Lake Superior; Great Slave Lake.

No. 127. L. SUBFUSCA, *Ach.*
Var. *glabrata*, Ach.
Hab. River St. Mary's, Lake Superior.

No. 128. L. SUBFUSCA, *Ach.*
Var. *epibrya*, Ach.
Hab. Mackenzie River; Great Slave Lake; Great Bear Lake.

No. 129. L. VARIA, *Ach.*
Var. *symmicta* (Ach.).
Hab. Great Bear Lake.

No. 130. L. GLAUCOMA, *Ach.*
Hab. Fort Enterprise.

No. 131. L. OREINA, *Ach.*
Hab. Great Bear Lake.

No. 132. L. TURFACEA, *Ach.*
Hab. Great Bear Lake.

No. 160. L. VERRUCOSA, *Laur.*
Hab. Mackenzie River.

Pertusaria, *DC.*

No. 133. P. leioplaca (*Ach.*).
Hab. River St. Mary's, Lake Superior.

No. 161. P. bryontha (*Ach.*).
Hab. River St. Mary's, Lake Superior.

Gyrostomum, *Fr. S. V. O.* p. 268.

No. 134. G. urceolatum, *Ach. & Fr.*
Conotrema urceolatum, *Tuck. Syn.* 86; *Zwachk. Exs.* 300!
Hab. River St. Mary's, Lake Superior.

Lecidea, *Ach. Nyl.*

No. 135. L. sanguineo-atra, *Ach.*
Hab. Great Bear Lake; Great Slave Lake

No. 136. L. turgidula, *Fr.*
Hab. Fort Enterprise.

No. 137. L. coarctata (*Ach.*).
Var. ornata.
Hab. Great Slave Lake.

No. 138. L. vesicularis, *Ach.*
Hab. Mackenzie River.

No. 139. L. tessellata, *Flk.*
Hab. Fort Franklin; Fort Enterprise.

No. 140. L. chalybeia, *Borr.*
Hab. Fort Enterprise.

No. 141. L. disciformis, *Fr.* (corticola).
Hab. Fort Enterprise; River St. Mary's, Lake Superior; York Factory; Great Slave Lake; Great Bear Lake.

No. 142. L. disciformis, *Fr.* (lignicola).
Hab. Fort Franklin.

No. 143. L. disciformis, *Fr.* (muscicola).
Hab. Fort Franklin.

No. 144. L. disciformis, *Fr.*
Statu ecrustaceo, *Nyl.*! *Moug. & Nestl.* 1328!
Hab. Fort Franklin.

No. 145. L. sabuletorum (muscicola).
Hab. Great Bear Lake.

No. 146. L. sabuletorum.
Var. *ligniaria*, Schær. L. H. 196!
Hab. Great Slave Lake.

No. 147. L. GEOGRAPHICA, *Ach.*
Hab. Great Bear Lake.

No. 148. L. PARASITICA, *Flk.* (L. inspersa, *Tul.*).
Hab. On *Peltigera* and *Hypnum*; Great Bear Lake.

No. 149. L. PUNCTATA.
Var. *denudata,* Schær. L. H. 529!
Hab. York Factory.

No. 150. L. PROTUSA, *Fr.*
Hab. Fort Enterprise.

No. 151. L. SPHÆROIDES, *Smrf. Nyl. Scand.* 204.
Hab. Great Bear Lake.

No. 163. L. ATROBRUNNEA, *Schær.*
Hab. Fort Enterprise.

VERRUCARIA, *Pers. Nyl.*

No. 152. V. NIGRESCENS, *Pers.*
Hab. Mackenzie River.

No. 153. V. GLABRATA, *Ach.*
Hab. Great Slave Lake.

No. 154. V. EPIDERMIDIS, *Ach.*
Hab. Great Slave Lake.

No. 155. V. FRANKLINIANA, *Leighton.* Thallus pallide cinerascens, opacus, tenuis, indeterminatus; apothecia parva, subinnata, nigra, sublucida, perithecio nigro, dimidiato, basi incurvescente; sporæ 4–8, mediocres, oblongæ vel ovoideo-oblongæ, murali-divisæ (septis horizontalibus 4) incolores; paraphyses graciles distinctæ; gelatina hymenea iodo vinose rubescens (præsertim thecæ). Ad corticem lævem Alni.
Hab. River St. Mary's, Lake Superior.

PLATE II.

Fig. 2. Asci, magn. 330 lin. Fig. 3. Spores magn. 1200 lin.

XYLOGRAPHA, *Fr. Nyl.*

No. 156. X. FLEXELLA, *Nyl.*
Hab. Great Slave Lake.

GRAPHIS, *Ach. Nyl.*

No. 157. G. SERPENTINA, *Ach.*
Hab. River St. Mary's, Lake Superior.
Imperfect; no sporidia distinguishable.

ARTHONIA, *Ach. Nyl.*

No. 158. A. TUMIDULA, *Leighton.* Thallus pallide cinerascens, opacus, tenuis; apothecia parva nigra, sessilia, subastroideo-difformia, convexa, papillosa; sporæ 8, magnæ, oblongæ, medio constrictæ, muralidivisæ (septis horizontalibus 7–8) fuscæ; gelatina hymenea iodo fulvescens. Ad corticem lævem Alni.

Hab. River St. Mary's, Lake Superior.

PLATE II.

Fig. 6. Ascus, magn. 330 lin. Fig. 7. Spores, magn. 1200 lin.

ODONTOTREMA, *Nyl.*

No. 159. O. RICHARDSONII, *Leighton.* Thallus macula albido-cinerascente dilatata indicatus; apothecia mediocria fusco-nigra, rotundata, adnata, patellariodea, pars excipuli superior dentibus multis versus centrum concavum concolor apertum radiatim vel conniventer versis; sporæ 4, incolores, aciculares vel vermiformes, arcuatæ, uniseptatæ; paraphyses graciles confertæ; gelatina hymenea iodo cærulescens, deinde vinose tincta.

Hab. On weathered wood, Fort Enterprise.

PLATE II.

Fig. 1. Spores, magn. 1200 lin.

On the Vegetation of the Western and Southern shores of the Dead Sea. By B. T. LOWNE, M.R.C.S. Eng. Communicated by Dr. HOOKER, F.R.S.

[Read April 6, 1865.]

THE least-known flora of Palestine is that of the Ghor or Jordan valley; and, as far as I am aware, the flora of the south of the Dead Sea valley was almost if not entirely unknown before my visit in January 1864, in company with the Rev. H. B. Tristram and his party. With the assistance of the Royal Society, and under the guidance of that distinguished traveller, I was enabled to stay several days in the least frequented and most dangerous part of the Dead Sea valley, and I propose with your leave to present to you this evening the results of my researches in that region.

General Character of the Vegetation near the Dead Sea.—The greater part of the western and southern shores of the Dead Sea, between Ain Terabeh and the oasis Es Saffieh, is quite destitute of vegetation, except occasional patches of *Lycium europæum*, *Salvia ægyptiaca*, *Lagurus ovatus*, and one or two composite plants which I have not been able to determine, owing to the state they were in at the time of our visit. At Ain Terabeh there is a dense thicket of reeds (*Arundo donax*) with a marsh of Salsolas, *Atriplex halimus*, and here and there a clump of Tamarisks, probably *T. Pallasii* or a species very near it. Ain Terabeh was the only place where I found *Æluropus lævis*; but Dr. Hooker found this remarkable grass nearer the northern end of the sea. Beyond Ain Terabeh, travelling south, except at Engedi, Saffieh, and on the flat plain between the Zuweirah and Mahauwat Wadies, all the vegetation I observed, except that already mentioned, were a few tamarisks, one or two small Acacia trees (*Acacia seyal*), and a single specimen of *Astragalus* with purple flowers (near *A. hypoglottis*, Linn.). Our march was, however, very hurried and fatiguing whilst passing over these desert regions, and I speak from memory and not from notes.

The banks of the streams at Engedi are in many places covered with luxuriant vegetation, dense thickets of reeds (*Arundo donax*), *Salix octandra*, and *Salvadora persica* overhanging them, with here and there a patch of *Typha latifolia*, and an apparently new species of *Pennisetum*; whilst immense fronds of Maiden's Hair Fern (*Adiantum capillus Veneris*) hang from the damp shady parts of the rocks. The general appearance of the oasis, however, is exceedingly desolate: the Arabs cultivate but little corn; and the

most conspicuous botanical objects in the landscape are groups of *Tamarix Pallasii*, *Moringa aptera*, *Acacia seyal*, *Zizyphus vulgaris*, and the curious and grotesque Asclepiad *Calotropis procera*, Br. *Retama monosperma*, Boiss., is also a common bush; but it flowers later, and was not a very conspicuous object in the vegetation at the time of our visit.

The oasis of Es Saffieh differs from that at Engedi in being better watered and therefore more fertile, and in being inhabited by settled and not by wandering tribes of Arabs. Unfortunately the curious Arab village had been sacked and burned the day before we arrived, by a lawless gang of Arabs from Petræa; and all its unhappy inhabitants had flown, leaving their corn-crops, and indigo, and the dead bodies of those who had fallen in fight behind them. As the enemy were apparently still lurking about, our survey of the district was necessarily hasty and imperfect. *Zizyphus vulgaris* and *Salvadora persica* are both most abundant at Saffieh, much more abundant than at Engedi, whilst *Calotropis*, although common, is much less common than at the latter place; with the exception of *Acacia seyal* and *Moringa aptera*, I saw no other trees and bushes at Saffieh, although I kept a sharp lookout, knowing at the time that Irby and Mangles had described the oasis as abounding in an almost infinite variety of shrubs and bushes.

The most curious and interesting locality in the south of the Ghor, however, is the delta-like flat which extends from the embouchures of the Zuweirah and Mahauwat Wadies to the shore of the Dead Sea, where I found 82 species of flowering plants, with few exceptions, quite peculiar to this limited region, as regards the Dead Sea valley and the rest of Palestine.

The Zuweirah and Mahauwat Wadies are two very deep gorges formed by the drainage of the eastern portion of the plateau of Beersheba and the hills between it and the Dead Sea, and which enter the Ghor just north of, and on the west side of, Jebel Usdum, about two miles from the Salt Lake. These two miles consist of a flat delta formed of tertiary deposits washed down and deeply channelled by occasional torrents, which, judging from appearances, must be rare and violent. The channels are exceedingly numerous, and vary from a few feet to many yards in breadth, and from two to eighteen feet in depth; and although at the time of our visit they were apparently perfectly dry even a foot or more beneath the surface, they were fringed with *Zizyphus vulgaris*, *Acacia seyal*, *Tamarix*, *Ochradenus*, and *Dæmia cordata*; and the

beds of the channels were dotted over with low scrubby bushes of *Fagonia* and *Gymnocarpum*, and with showy tufts of *Cleome trinervia* and *Salvia controversa*. In fact, the whole of the 82 species which I found were, with few exceptions, confined to the channels or their immediate vicinity, and every plant seemed to be in flower; yet we had to send nearly two miles up the Zuweirah Wady for water, which existed only in deep rock-pools, the remains of former rains. The entire delta has a very desolate aspect. The Rose of Jericho (*Anastatica*) grows in its dryest parts; but it is fringed at the edge of the lake by a bright green marsh of Salsolas.

On examining the list of plants which I found in this region, it will be seen that the flora, although very different from the flora of the rest of Palestine, is essentially Mediterranean in type. Its affinities, however, are all with the floras of northern Africa, especially with the desert-floras of Upper Egypt and Nubia. It will also be found to be closely related with that of Aden in the south, and the Canaries in the west. The flora of this delta appears, moreover, to be precisely similar to that of Arabia Petræa; at least I am led to this belief by a comparison of it with the collection made there by Major M'Donald, now in the Herbarium at Kew.

It will be seen, on examining the lists I have appended to this paper, that, of the 94 species collected by myself in the south of the Dead Sea valley, 29 or 30 only are European plants; and these are chiefly weeds of a very wide distribution: why such plants as *Tribulus terrestris*, *Emex spinosus*, *Solanum nigrum*, and *Capsella bursa pastoris* should form so large a part of the European element in this flora, I am unable to form any idea. With the exception of one or two, all these 29 or 30 species extend into northern India; many have a much wider distribution.

On the other hand over 50 species are decidedly African, not extending into Europe; and many of these are exceedingly local; not more than one-third extend into India; and those which do are chiefly natives of Sind and Affghanistan, affecting arid regions: and none of these African species seem to have a very w distribution, with the exception of *Ærua javanica*.

Although two of the most remarkable forms of the southern Ghor, *Calotropis procera* and *Salvadora persica*, are Indian plants, yet these are equally common in Upper Egypt and Nubia; so that I do not think there is anything to warrant the ordinary belief that the flora of the south of the Ghor has an Indian type.

Excluding the exceedingly widely distributed European plants

between 30 and 40 of the species of the southern Ghor extend into Sind, and about 13 are found in the Canary Isles: this appears to me a fact worthy of note, since these countries are upon the eastern and western limits of the North-African desert-flora.

The relation which the southern Ghor bears to that of the peninsula of Aden, seeing how little is known of the botany of central Arabia, seems to me a subject of special interest. Eleven of the most characteristic plants of the southern extremity of the Dead Sea valley are common to it and to the peninsula of Aden; and, considering how very limited the floras of the two localities are, this is not an unimportant number. In both places *Reseda amblyocarpa* seems to be by far the most common plant.

In both places the number of species and genera is small compared with the number of natural orders to which they belong. My 94 species belong to 33 orders, giving an average of rather more than three species to each.

The most numerous orders in the flora of the Dead Sea are—

Cruciferæ,	containing	13	species;
Compositæ	„	11	„
Leguminosæ	„	6	„
Chenopodiaceæ	„	6	„
Zygophyllaceæ	„	5	„

whilst at Aden, according to Griffith's Floricula, published in your 'Transactions,' there are

11	species of	Leguminosæ,
9	„	Capparideæ,
7	„	Euphorbiaceæ,
5	„	Compositæ,

showing the much more decided tropical character of the latter flora.

None of the plants peculiar to Aden were found by me in the Dead Sea valley; and I know of only one well-marked species peculiar to this region and to the north of Arabia and the adjacent deserts of Suez and Persia, the *Cleome trinervia*, Fresen., which is the most characteristic plant of northern Arabia.

Lastly, I may mention that I found two most distinct varieties of *Fagonia* common about the Zuweirah and Mahauwat Wadies—one, the *F. sinaitica* of Boissier, a creeping plant, and the other the common Levant species; these plants, growing side by side in abundance without any intermediate forms, seem to me to point to two distinct species of *Fagonia*, however wide their distribution and variation may be.

I. *The Desert-Flora of Zuweirah and Mahauwat Wadies.*

CRUCIFERÆ.

1. Mathiola oxyceras, *DC.*
2. Mathiola sinuata.
3. Zilla myagroides, *Forsk.*
4. Notoceras canariense, *R. Br.*
5. Farsetia ægyptiaca, *Turcz.*
6. Nasturtium coronopifolium, *DC.*
7. Anastatica hierochuntina, *L.*
8. Neslia paniculata.
9. Brassica Aucheri, *Boiss.*
10. Enarthrocarpus strangulatus, *Boiss.*
11. Hesperis, sp.
12. Erucaria, sp.
13. Carrichtera vella, *DC.*

CAPPARIDEÆ.

14. Cleome droserifolia, *Delile.* Probably the same as *quinquenervia*, DC.
15. Cleome trinervia, *Fresen.*

RESEDACEÆ.

16. Reseda crystallina, *Webb.* Probably a var. of *odorata.*
17. —— amblyocarpa, *Fresen.*
18. Oligomeris glaucescens, *Camb.*
19. Ochradenus baccatus, *DC.*

TAMARICINEÆ.

20. Tamarix tenuifolia, *DC.*? } affines sp.
21. —— Pallasii, *Desv.*? } affines sp.
22. Reaumuria palestina, *Boiss.* Probably the same as *vermicularis*, L.

ZYGOPHYLLACEÆ.

23. Fagonia cretica, *L.*
24. —— sinaitica, *Boiss.*
25. Nitraria tridentata, *Desf.*
26. Gymnocarpum fruticosum, *Pers.*
27. Tribulus terrestris, *L.*

RUTACEÆ.

28. Ruta tuberculata, *L.*

AZOIDEÆ.

29. Azoon canariense, *L.*

RHAMNACEÆ.

30. Zizyphus vulgaris, *L.*

LEGUMINOSÆ.

31. Retama retam, *Webb.*
32. Astragalus, sp. resembling *gummifer.*
33. Lotononis Leobordea, *Boiss.*
34. Trigonella hamosa, *L.*
35. Acacia seyal, *L.*
36. Vicia narbonensis, *L.*

COMPOSITÆ.

37. Anvillea Garcini, *DC.*
38. Asteriscus pygmæus, *Cass.*
39. —— graveolens, *DC.*
40. Pulicaria undulata, *DC.*
41. Pyrethrum auriculatum, *Boiss.*
42. Zollikoferia chondrilloides, *DC.*
43. Picridium tingitanum, *Desf.*
44. Microrhynchus nudicaulis, *Less.*
45. Trichogyne cauliflora, *DC.*
46. Senecio Decaisnei, *DC.*
47. Leyssera capillifolium, *DC.*

CUSCUTACEÆ.

48. Cuscuta, sp.

SOLANACEÆ.

49. Solanum nigrum, *L.*

BORAGINEÆ.

50. Heliotropium luteum, *Pers.*
51. —— hispidum, *Forsk.*
52. Trichodesma, sp.
53. Onosma syriaca, *Labill.*? A small variety.

ASCLEPIADEÆ.

54. Dæmia cordata, *R. Br.*
55. Lycium europæum, *L.*

LABIATÆ.

56. Salvia ægyptiaca, *L.*
57. —— controversa, *Fen.*
58. Lavandula multifida, *L.*

SCROPHULARINEÆ.

59. Verbascum undulatum, *Lam.*
60. Scrophularia variegata, *Bieb.* probably a var. of canina.
61. Antirrhinum orontium.
62. Linaria floribunda, *Boiss.*
63. —— sp.

PLANTAGINEÆ.

64. Plantago, sp.

PLUMBAGINEÆ.

65. Statice pruinosa, *Delil.*

AMARANTHACEÆ.

66. Ærua javanica, *Juss.*

POLYGONEÆ.

67. Rumex vesicarius, *L.*

CHENOPODIACEÆ.

68. Echinopsilon muricatus, *Moq.*
69. ——, sp.
70, Salicornia fruticosa, *L.*
71. Sueda, sp.
72. Atriplex halimus, *L.*
73. Salsola, sp.

JUNCACEÆ.

74. Juncus maritimus, *L.*

GRAMINEÆ.

75. Aristida plumosa, *L.*
76. —— Adscensionis, *L.*
77. Andropogon, sp.
78. Schismus minutus, *R. S.*
79. Æluropus lævis, *Trin.*
80. Panicum Teneriffæ, *R. Br.*
81. —— turgidum, *Forsk.*
82. Pennisetum cenchroides, *Reich.*

At Engedi I also found

1. Moringa aptera, *DC.*
2. Calotropis procera, *Br.*
3. Salix octandra, *DC.*
4. Arundo donax, *L.*
5. Salvadora persica, *L.*
6. Forskahlea, sp.
7. Zizyphus lotus, *DC.*
8. Loranthus acaciæ, *DC.*
9. Pennisetum, sp.
10. Typha latifolia, *L.*
11. Abutilon muticum, *DC.*
12. —— denticulatum, *DC.*

And these plants, except *Forskahlea* and *Moringa* and the three *Malvaceæ*, were observed by me at Es Saffieh. Except *Moringa aptera* and *Loranthus acaciæ*, these are all Indian species. *Salix octandra* extends into Affghanistan. They are all also Egyptian, including both *Moringa* and *Loranthus*.

II. *List of Plants found in the Wadies at the south of the Dead Sea, which occur in*

1. The CANARY ISLANDS.

1. *Fagonia cretica**.
2. *Notoceras canariense.*
3. Gymnocarpum fruticosum.
4. Azoon canariense.
5. *Trichogyne cauliflora.*
6. Senecio Decaisnei.
7. Salvia ægyptiaca.
8. *Pennisetum cenchroides.*
9. Reseda crystallina.
10. *Atriplex halimus.*
11. Statice pruinosa.
12. *Panicum Teneriffæ.*

2. The FLORA of ADEN.

1. *Fagonia cretica.*
2. Abutilon denticulatum.
3. Reseda amblyocarpa.
4. Cleome droserifolia.
5. *Zizyphus lotus.*
6. Moringa aptera.
7. Salvadora persica.
8. Ærua javanica.
9. *Pennisetum cenchroides.*
10. Aristida Adscensionis.
11. —— plumosa.

* The species in Italics are found in Europe.

3. Europe.

*1. Notoceras canariense.
2. Mathiola sinuata.
*3. Fagonia cretica.
*4. Neslia paniculata.
*5. Capsella bursa pastoris.
*6. Zizyphus lotus.
*7. Tribulus terrestris.
8. Retama retam.
*9. Vicia narbonensis.
*10. Zollikoferia chondrilloides.
*11. Trichogyne cauliflora.
*12. Inula crithmoides.
*13. Solanum nigrum.
*14. Lycium europæum.
*15. Salvia controversa.
*16. Lavandula multifida.
*17. Scrophularia canina.
*18. Antirrhinum orontium.
*19. Verbascum undulatum.
*20. Rumex vesicarius.
*21. Emex spinosus.
22. Balanophora coccinea.
*23. Typha latifolia.
*24. Juncus maritimus.
*25. Arundo donax.
*26. Pennisetum cenchroides.
27. Panicum Teneriffæ.

4. Africa, but not in Europe.

†1. Mathiola oxyceras.
2. Zilla myagroides.
3. Anastatica hierochuntina.
†4. Farsetia ægyptiaca.
5. Brassica Aucheri.
6. Enarthrocarpus strangulatus.
7. Nasturtium coronopifolium.
†8. Cleome droserifolia.
9. Reseda amblyocarpa.
10. Oligomeris glaucescens.
†11. Ochradenus baccatus.
12. Tamarix tenuifolia.
13. —— Pallasii?
14. Fagonia sinaitica.
15. Nitraria tridentata.
16. Ruta tuberculata.
†17. Abutilon denticulatum.
†18. —— muticum.
†19. Sida asiatica.
‡20. Gymnocarpum fruticosum.
21. Reaumuria palestina.
22. Azoon canariense.
23. Moringa aptera.
24. Lotononis Leobordea.
25. Trigonella hamosa.
26. Acacia seyal.
27. Asteriscus graveolens.
28. Pulicaria undulata.
29. Pyrethrum auriculatum.
30. Senecio Decaisnei.
†31. Microrhynchus nudicaulis.
‡32. Picridium tingitanum.
33. Leyssera capillifolium.
34. Heliotropium luteum.
35. —— hispidum.
†36. Trichodesma, sp.
†37. Calotropis procera.
38. Dæmia cordata.
†39. Salvia ægyptiaca.
40. Linaria floribunda.
†41. Ærua javanica.
42. Forskahlea, sp.?
†43. Salvadora persica.
44. Echinopsilon muricatus.
45. Salix octandra.
46. Statice pruinosa.
†47. Aristida Adscensionis.
†48. —— plumosa.
†49. Schismus minutus.
50. Æluropus lævis.
51. Panicum turgidum.

* These species have all a very wide distribution, especially the *Capsella*, *Tribulus*, *Solanum*, *Emex*, and *Juncus*, which are worldwide.

† These species extend into Northern India.

‡ *Gymnocarpum fruticosum*, and *Picridium tingitanum*, extend into Sicily.

List of Orders and Number of Species in each.

13 Cruciferæ.	2 Asclepiadeæ.
11 Compositæ.	1 Moringeæ.
10 Gramineæ.	1 Rhamnaceæ.
6 Leguminosæ.	1 Salvadoraceæ.
6 Chenopodiaceæ.	1 Loranthaceæ.
5 Zygophyllaceæ.	1 Plantagineæ.
5 Scrophularineæ.	1 Plumbagineæ.
6 Resedaceæ.	1 Amaranthaceæ.
4 Boragineæ.	1 Urticaceæ.
3 Tamariscineæ.	1 Polygoneæ.
3 Labiatæ.	1 Amentaceæ.
2 Cappárideæ.	1 Typhaceæ.
2 Solanaceæ.	1 Juncaceæ.

Notes on the Flora of the Desert of Sinai. By RICHARD MILNE REDHEAD, Esq., F.L.S. & R.G.S.

[Read April 6, 1865.]

I HAVE written the following notes on the flora of the Desert, more especially the Sinaitic part of it, from memoranda made, and specimens collected, during a tour in the East in the months of February, March, and April 1864, in the hope that, slight as is the information contained in them, it may be of use to those who (as I did), before leaving England, search almost in vain for information on this subject.

I reached Alexandria on the 11th of February, too early to see its flora to advantage; but what I saw did not give promise of much variety. The only trees outside the enclosed gardens of the merchants are *Phœnix dactylifera*, of which there are extensive groves within the fortifications, and which grow luxuriantly in the saline soil, *Tamarix orientalis*, and *Acacia lebbekh*, both planted in avenues along the roads by Mehemet Ali,—the former dusty and stunted in growth, the latter with large yellow pods hanging from its almost leafless branches.

The waste ground, now being gradually built upon as the modern city expands over the deserted site of its ancient predecessor, is thinly covered with vegetation, the most noticeable plants being a small yellow-flowered *Eruca* (*E. sativa*), a white-flowered *Erucaria* (*E. aleppica*), and the bright-orange *Calendula officinalis* all very dwarf: great quantities of a *Mesembryanthemum* (apparently *M. crystallinum*) were springing from seed. On the banks of the Mahmoudieh canal I remarked a kind of *Cyperus*

(*C. badius*), and in the gardens of the numerous villas many fine exotics, which we in England are unused to see in the open air, as *Poinsettia pulcherrima*, *Sparrmannia africana*, *Habrothamnus*, and various *Cassiæ*, *Meliæ*, *Cæsalpiniæ*, *Acaciæ*, *Bauhiniæ*, &c.

The Mohammedan cemeteries are thickly planted with a species of Aloe, now bearing spikes of orange flowers.

At Cairo everything was suffering from recent severe frosts, a most unusual occurrence there. The plantains and sugar-canes were almost destroyed; and the trees in the open space called Ezbekeëh were much shrivelled, the only one in flower being the fragrant *Acacia farnesiana*; the venerable *Ficus sycomorus*, at Matareëh, said traditionally to be the one under which the Holy Family rested during their flight, showed in its dry, brittle foliage the effects of the unusual cold as clearly as did the dead branches of the orange-trees in the same garden. The sycamores on the banks of the Nile at Old Cairo were less affected by the cold, and were bearing their fruit abundantly, growing as it does in a singular manner out of the gnarled trunk of the tree, and not amidst the the foliage.

In the sandy tract just before reaching the Pyramids, I found the lovely *Iris sisyrinchium* (*S. majus*) in profusion, its elegant and fragrant flowers contrasting vividly with the yellow sand in which it grew: it was the only plant I saw in flower in the neighbourhood of Cairo.

We started from Cairo to cross the Desert, on camels, on the morning of February 24. Few tracts on the earth's surface can be less interesting botanically than the Desert immediately east of Cairo. Leaving behind us the domes and minarets of the city, and the dark green valley of the Nile, we enter at once upon a vast undulating plain of grey gravel (with fragments of silicified wood), broken at intervals by sandy hillocks.

Sea-like in its vastness and in its silence, it is entirely devoid of vegetation; and our course was by no means enlivened, although most distinctly marked, by the bleached skeletons of camels, which line the track all the way to Suez; a few grey eagles soaring above, and a sand-coloured cricket, were the only living things we saw during our first day's journey; the next day we found some dead shells of a Helix, indicating our approach to vegetable life, and at the time of our midday halt, near the sixth station*,

* These stations were erected, for the accommodation of travellers between Cairo and Suez, prior to the construction of the railway.

our eyes were gratified by the appearance of a few plants, viz.:—

Zilla myagroides (Arabice *Silleh*), glaucous and prickly, with a lilac flower much resembling our *Cakile maritima*; a dwarf, shrubby Composite, not yet in flower, *Santolina fragrantissima* (Arab. *Abei thirân*), which our camels snatched at most greedily; an *Astragalus* (*A. tumidus*) of the Tragacanth group, with very long grey spines, small yellowish flowers, and downy, bladder-like calyx. I also remarked a dead *Arenaria*, much like our *A. rubra*, and the dry remains of an umbelliferous plant.

Not far from the track, on our right we espied a solitary tree, of which the leafless branches were hung with rags; indeed its Arabic name is "Om e sharameet"—"the mother of rags:" it is said to have sprung from Mahomet's staff, which took root on his striking it into the ground. It is an *Acacia* (*A. nilotica*).

The great paucity of vegetation is amply accounted for by the extreme aridity of the sandy gravelly soil, which has at Bir el Bŭtr been pierced to the depth of 85 feet without finding any water; the ground is thickly strewn with coarse jaspers, chalcedonies, and variously coloured flints.

On the third day we crossed numerous sandy wadies—slight depressions which, in rainy seasons, are watercourses; in these we found many plants of a Broom, *Spartium monospermum* (Arab. *Retem*), now coming into flower, its pretty white corolla just showing through the purple calyx; this is said to be the tree translated "juniper" in our English version (1 Kings, xix. 4, 5). This shrub, with the *Santolina* before named, from this time was of constant occurrence throughout our route until we approached the frontier of Palestine; and when at a later part of our journey it was in full bloom, we found it very fragrant.

We encamped in the Wady Bahram, or Valley of Waters, in which were traces of a recent torrent; and here were numerous thick tufts of *Spartium*, *Zilla*, and *Santolina*: our camels were tempted by this unwonted feast to wander away from the encampment; and some even were not forthcoming when we should have started the next morning, having wandered far towards Gebel 'Atâkah. I found here a pretty little Crucifer, *Ricotia ægyptiaca*, with silicles hanging on most delicate filiform stalks.

Suez we reached on the fourth day. Its vicinity is unutterably barren, dry, and scorched, without so much as a blade of grass; doubtless the freshwater canal only just completed will work wonders in fertilizing this and the other districts through which

it passes. There is, even at Suez, an oasis in the desert, in the P. and O. hotel, of whose hospitality we were glad to avail ourselves, as, owing to the wandering propensity of our camels, our tents did not arrive until night.

The following day we crossed the Red Sea by boat, and were landed on the shores of Asia by being carried on men's backs through the shallows of the gulf opposite to 'Ayûn Mûsa, pleased, as we landed, to observe the various species of *Murex*, *Tridacna*, *Pteroceras*, *Nerita*, and *Fusus* which abundantly strewed the shore. The sand here is quite oolitic in character.

Our tents were pitched near the springs of 'Ayûn Mûsa, around which are growing thickets of *Tamarix*, dwarf date-palms, and *Arundo donax*, under whose shade some culinary vegetables are with difficulty raised. Being the only spot with any claim to verdure for many miles around Suez, its limited vegetation is highly prized by the European inhabitants of that dreary town. The verdure, meagre as it is, is confined exclusively to the immediate vicinity of the muddy pools which give name to the spot, and which are soon absorbed by the sandy soil.

Leaving our encampment, we crossed wastes resembling the sandhills of the Lancashire coast, but without the "Star" (*Psamma*, *Elymus*) which there flourishes; and the interest of the journey was confined to the varying but exquisite colours of the Red Sea, at some parts of the deepest blue, whilst at other places it was of the loveliest emerald-green: beyond it was the fine outline of Gebel 'Atâkah (the Mountain of Deliverance) and the Libyan hills. The temperature this day, February 29, was 105° in the open air, and the heat radiated from the shining talcose gravel was intense.

When we encamped in Wady Sûdr, I found a strong torrent had recently poured down towards the sea, leaving the ground caked over with fine white clay, which crackled like egg-shells under the feet; and here were growing *Alyssum maritimum*, a half-shrubby *Farsetia* (*F. cheiranthoides*), and abundance of the *Spartium*, *Zilla*, and *Santolina*, all more advanced than in the Suez desert.

We were glad the following afternoon to leave the monotonous plain and enter a wady winding amid sandy, flint-sprinkled hillocks, and towards evening reached the mound of sand and tufa-like rock on which is the single pool of bitter water, called "Ain el Hawâra," no doubt the "Marah" of Scripture. Here were growing a few dwarf palms, and thick tufts of a prickly shrub, bearing thinly scattered, glaucous, fleshy leaves, *Nitraria tridentata*,

the "Ghûrkûd" of the Arabs: its greenish spikes of inconspicuous flowers were now appearing here; but on the following day, in the Wady Ghŭrŭndel, I found the small, oval, scarlet berry, with subacid flavour, fully ripe: the leaves in taste resemble our sea-coast Atriplex. It has been alleged that the "Ghûrkûd" was the plant employed by Moses to sweeten the water of Marah; the change, however, was certainly miraculous; at present the water has the saline taste of a weak solution of Epsom salts.

We rode on by starlight, the air loaded with the perfume of *Mathiola odoratissima*, which was henceforward of frequent occurrence in the Desert, and of most delicious fragrance.

Our encampment in Wady Ghŭrŭndel was in the midst of a thicket of Tamarisks, the first trees seen since we left 'Ayûn Mûsa. Here *Nitraria* grew abundantly, and I first saw its bright scarlet berry—the crop of which, however, would not be ripe for some months, as the plant was hardly yet in flower. The camels eat this shrub with greediness; and as a consequence the bushes are cropped into dense rounded tufts, the inside of which forms a cone of sand: the plant is the invariable accompaniment of salt springs.

With this wady, Ghŭrŭndel, commences the grand scenery of the peninsula, which gradually increases in sublimity until it reaches its climax in Mount Serbâl and Mount Sinai itself. Leaving behind us the sandy and flint-covered plain, our path winds amidst chalky hills of most fantastic outline, their denuded sides banded with horizontal streaks of brown and yellow, and their summits capped with dark gravel: on our right was the sombre mass of Gebel Hammâm Faraôn, so called from its hot sulphur-spring said to have been frequented by the Egyptian monarchs; the proximity of mineral waters was proved by our frequently passing masses of tufa and coarse travertine.

We descended into Wady Useit, in which grow many tufts of dwarf date-palm, and tamarisk, around some muddy pools of water; the whole ground is thickly coated with a saline incrustation: here was growing, on the roots of the *Spartium monospermum*, a really noble *Orobanche*, 18 inches high, of the most bright golden yellow, and extremely succulent. *Asparagus horridus* was plentiful here, scrambling over the "Retem" bushes, in some places forming a dense, tangled mass.

In the next valley, Wady Thâl, grew finer palms than we had hitherto seen in the Desert, and many shrubs, or low trees, of the "Seyal," *Acacia seyal*, which has a reddish trunk, and much-

twisted branches, armed with long grey spines (many as much as four inches and upwards in length). The trees were only just coming into leaf, and no flowers were visible; yet I found one or two quite young tender seed-vessels, as though the plant occasionally threw out flowers during the winter season: the same thing I have before remarked in the case of the *Nitraria*.

It was most refreshing to reach Wady el Taiyibeh, "the good valley," with its comparative abundance of water and the constant accompaniment of that element in this region, verdure. Graceful tufts of wild date-palms overhung the shallow stream, in which I was pleased to recognize our English *Nasturtium officinale*, and along with it (as I believe) its frequent companion *Sium nodiflorum*.

Mathiola odoratissima was most abundant, and each night perfumed the air with its fragrance.

Spartium monospermum was here and henceforward in full beauty; and a charming shrub it is; it often afforded us, as it did the prophet of old, a certain amount of shelter under its branches. This valley is hemmed in by precipitous walls of sandy rock of most varied colouring: beginning with the white of the chalk, we have many shades of grey, yellow, olive-green, brown, and red varying to purple, up to the black masses of trap rock. On these rocks we for the first time in the Desert found the *Capparis spinosa* (Arab. *Asaf*, or *Lasaf*), growing in bright green tufts, hanging down from the clefts of the rocks, with far more robust and fleshy leaves than in Italy or Sicily.

We encamped in a delightful spot not far from the Red Sea, called Abu Selîma, in the midst of magnificent scenery: the little plain is bounded by a chain of hills unparalleled in the gorgeousness of their colouring; it is strewn with their débris, granite boulders of a reddish colour, and is thickly covered with shrubs of dwarf olive-green *Salicornia*. On the shore were enormous masses of white coral (*Madrepora*), some spreading like ferns from a central root, with a diameter of a yard and more. I was pleased to find on the shore here the lovely *Trochus Pharaonis*, and various *Phasianellæ*, *Cardiæ*, *Margaritiphoræ*, &c.

Our course the following day, March 3, led us close along the shores, the rocks at one place projecting so far as to compel the camels, greatly against their inclination, to wade in the sea. On reaching the plain El Murkhâh, where as at Abu Selîma, there is much *Salicornia*, we for the first time approach the granite of the higher ranges of the peninsula, and, entering Wady Shellâl, find

a number of plants hitherto unseen by us: conspicuous amongst these are large tufts of *Scopolia Bouiana*, with handsome, veined, purple flowers resembling a Petunia, and fleshy strong-smelling leaves; numerous shrubs with a silvery stem, and thinly-scattered, conjugate, fleshy leaves, and white flowers, *Zygophyllum album*; a *Reseda*, I think identical with the European *R. odorata*, but very dwarf, and, like it, deliciously fragrant; another *Reseda*, with its lower leaves always red (*R. undata*); a curious yellow and brown-flowered *Cleome* (*C. ornithopodioides*), so viscid that the sand adheres to it even when dry in the herbarium (as is also the case with *Scopolia*); a noble yellow-flowered *Astragalus* [?*A. tomentosus*]; large quantities of *Ricotia*, *Mathiola*, and *Malcomia*, a sweet-smelling *Anthemis tomentosa*, the *Zilla*, here most luxuriant, and many bushes of a curious, twiggy, almost leafless plant, bearing spikes of insignificant yellowish flowers, and small white pearly berries, *Ochradenus baccatus*; this is a favourite food of the camels, who lose no opportunity of nibbling at the uninviting, juiceless stems. The place of grass is here supplied by the pretty *Asphodelus fistulosus*, at this time in full bloom. Another genus now made its appearance, and we saw one or another of the three prevailing species all the way through the Desert hence to the frontier of Palestine, but especially in the Desert of Nŭhkl; this is *Fagonia*—dwarf, prickly-leaved plants, with pink flowers; one, the commonest species, *F. cistoides*, in many places spreads so as to form dense masses several yards round, and not above three or four inches high.

At the rocky staircase, called Nŭkb Buderah, by which we ascend to the higher region of the peninsula, I found the pretty little trailing, yellow-flowered *Zygophyllum simplex*. The family Zygophyllaceæ seems to occupy here the place of Crassulaceæ in more northern latitudes.

In Wady Magârah and Wady Ginneh the same plants occurred, with the addition of *Heliotropium supinum*. Here is the encampment of the "King of Sinai," Major Macdonald, to whose introduction we were indebted for the hospitality of his representative, Mr. McNeill, the Major being then at Alexandria. Here we dined on Ibex soup, Ibex cutlets, stewed Ibex, and a delicious salad, with tomatoes grown in the small enclosed garden: I thought the flesh of the Ibex excellent, something between lamb and veal, and very tender. A young one of this species (*Capra sinaitica*) follows Mr. McNeill, jun., about like a dog. There were several heads of the animal here, with noble recurved and ringed

horns fully a yard in length. A skin was shown to us of a panther, or leopard, of a pale yellow, thickly spotted with black, which had been shot in the neighbourhood.

Mr. McNeill spoke of collecting seeds of the plants growing in the adjacent wadies, and sending them to the gardens at Kew. It is to be hoped that he may carry out this intention.

Our next day's journey took us into Wady Feirân, the most fertile valley of the peninsula, a complete oasis in the Desert, glorious in its scenery, overhung by the mighty and picturesque mass of Mount Serbal, whose granite peaks rise to the height of 6759 feet above the sea; rich in the verdure of its luxuriant groves of fruit-bearing date-palms, it contained not only all the Desert plants previously named, especially the *Spartium*, the *Zilla*, the *Santolina*, the *Scopolia*, and the *Fagoniæ F. myriacantha*, *F. sinaitica* and *F. cistoides*, but also numerous species which we had not hitherto observed—such as the pretty but unfragrant *Cleome chrysantha*, the *Anacyclus orientalis* (*Cotula*) with as agreeable a perfume as the other is unpleasant, *Leyssera capillifolia* (*Longchampsia*), several species of *Silene*, *Gypsophila vaccaria*, *Hyoscyamus pusillus* with yellow flowers and deeply toothed leaves, a great deal of the *Cleome ornithopodioides* growing together with our own *Trifolium stellatum*. Here too were numerous trees, now in full bearing, of the *Zizyphus lotus* (Arabice *Nŭbk*) : I found the reddish orange fruit, which in size and form much resembles a Siberian Crab, very pleasant to the taste; it contains a single, round, hard stone.

Quitting this fertile valley, the scenery as well as the botany is for some hours far less interesting. In the wide open Wady-es-Sheikh, the *Santolina fragrantissima* grows in enormous quantity in the greatest luxuriance. The camels are constantly cropping it; and as it is now in full flower, its scent quite loads the air as the animals pass through it: not unpleasant when fresh, the desert-traveller soon becomes heartily sick of the odour of this plant, as, after mastication by the camels, it gives their breath a most nauseatingly offensive smell, and one soon learns to prevent as much as possible their eating this plant, and to approve of the *Zilla* as their food, as it leaves their breath untainted. I found here another fine yellow *Astragalus* (? *A. christianus*), and on rocks a pretty *Rumex*, *R. vesicarius*, which has large, membranous, shining seeds, and foliage in appearance and flavour very like *Oxyria reniformis*, excellent as a salad. At Nŭkb Hâwy, the second steep rocky stair by which we ascend to the very heart of

the peninsula, was growing a lovely little *Stipa*, with feathery beard of about an inch long, ⅓rd the whole height of the glaucous plant*.

And now we approach the central and most elevated district of the peninsula, and, crossing the great arid plain Er-râhah amidst red and yellow granite peaks, we have in front the vast mass of Horeb, with the triple peaks of Ras-es-Sâfsafeh overhanging the plain, a mountain-range sanctified long ages since by the more immediate presence of the Most High, and which appears even now, in the extreme fragrance of its herbage, to offer a continued incense to Him at whose presence (Exodus, xix. 18) "Mount Sinai was altogether in a smoke, because the Lord descended upon it in fire."

Certainly the approach to Sinai by the plain Er-ràhah is one of the grandest scenes it has fallen to my lot to behold. It is not here the place to speak of the convent or the church of Saint Catherine; but I may note that in the well-watered garden the almond-trees (March 6) are now covered with blossom, as are also the plums and pears, their pink and white flowers contrasting charmingly with the dark green of the numerous cypress and orange-trees, and the silver grey of the luxuriant olives. By the courtesy of the Hegoumenos we tasted the fruit of the orange-trees and found it sweet and well flavoured, which surprised me, as I am told that not unfrequently water is frozen in the cells of the convent, and the trees appear to have no protection.

As yet, owing to the early period of the year (March 7), and the elevation of the district, there are few plants in flower here; but during our ascent of Gebel Mûsa, followed by that of Ras-es-Sâfsafeh, two points especially struck me,—first, the great preponderance of scented, and especially of Labiate plants; and secondly, the very woolly, tomentose character of those not Labiates.

As we ascend behind the convent, the first plant of interest is one common enough in the south of Europe, but noteworthy here as the only fern seen in the peninsula, *Adiantum capillus-Veneris*, which grows freely in a small rocky recess overhanging a clear spring about twenty-five minutes' walk above the convent; the fronds are small, for the most part barren, with deeply-divided pinnules. We now ascended a rugged but most picturesque path between vast masses of fallen granite, amid which grow bushes of *Phlomis fruticosa*, to the chapel of the Panagia, who is said to have

* I am informed that this plant grows throughout the Sahara, the African desert.

miraculously delivered the convent, if not from the genus *Cimex*, at all events from that of *Pulex*. Many of the unorthodox discredit this alleged deliverance; for myself, I had no cause to disbelieve it, unless my own immunity from attack was owing to the many powerful-smelling herbs I had brought with me. Another most romantic rock staircase brought us to a small and verdant plain, a comparatively level spot, nestling amid the wild granite peaks, one of the highest of which, Gebel Mûsa, the traditional Sinai, now rose in front of us: in this plain stands a solitary cypress, the only tree I saw after leaving the convent. A spring of fresh water (that of Elijah) is here (as elsewhere in the desert) the cause of the verdure; close by is the Cave of the Prophet, where he is said to have heard the "still, small voice." Hence the ascent is more steep, and we crossed some large patches of snow, in places as much as three feet deep. The plants I noted were,—a very fragrant *Tanacetum* or *Artemisia*, not in flower, with pinnated, downy leaves; *Marrubium pseudodictamnus*, not in flower; *Teucrium fruticosum*, in bloom; *T. flavescens*, also in flower sparingly; an *Origanum*, not in flower; *Ajuga chia*; *Thymus vulgaris*, in flower, with two or three other species not yet open, and two plants not in flower—I think *Satureja montana* and *S. Juliana*, which have an odour greatly resembling the incense used by the Greek Church, and which I was told are gathered by the monks for some ecclesiastical purpose; *Salvia clandestina*, with pale lilac flowers and woolly pinnatifid leaves; and two species of *Silene*, one dwarf and white, the other pink-flowered (*S. orchidea*). On the very summit of Gebel Mûsa, at an elevation of 7035 feet above the sea, was growing *Herniaria glabra*; and *Peganum harmala* was just beginning to shoot up from the root.

I must not pause to dilate upon the wondrous panorama of blasted peaks, of surpassing interest, seen from this point, but will only add that I was fortunate in seeing, amongst the huge blocks of granite just under the summit, two specimens of a rufous-coloured animal, with whitish belly, much like a Guineapig, which I believed to be the *Hyrax syriacus*, or Coney: they were here literally inhabiting the "stony rocks."

In descending we diverged towards the road made by order of Abbas Pasha, and there, as we had been informed, we found some good specimens of dendritic stones, with the *Lycopodium*-like markings very distinct upon the reddish granite. We afterwards traversed the central valleys of the Horeb range to the foot of the Ras-es-Sâfsafeh, where there is a small spring and much grass,

including our own *Festuca vivipara*; and we saw also the Willow-bush (Sâfsaf), from which the peak above takes its name: it was not yet in leaf, nor were there upon it any catkins. Regretting that, owing to the depredations of tourists, a plant so interesting, as giving a name to the summit above, should be destroyed, I stuck several cuttings into the moist ground, and hope that thus the Willow may be perpetuated. The ascent of the Ras-es-Sâfsafeh is extremely steep; but the glorious view from its summit of the great plain Er-râhah, directly below, no doubt the camping-place of the Israelites, fully repaid us for our fatigue. On this hill I found a *Verbascum*, with a yellowish leaf as thick as a piece of felt, a small *Malcomia*, a neat *Farsetia* (*F. lunarioides*, abundance of *Phlomis*, a *Senecio* much like our Ragwort, and several Boragineæ with (like all the above) yellow flowers—I believe, *Onosma echioides*, *Lithospermum orientale*, and a yellow-flowered *Anchusa*.

The eastern side of the peninsula is on the whole more rich in vegetation than the western valleys, Feirân alone excepted.

Thus the *Acacia seyal* is not only much more frequent, but grows to a far larger size, and is less damaged by the Arabs, who cut them up for charcoal. I failed to discover any second species of *Acacia* in the peninsula (as far as I am able to judge, not having seen the trees in flower); there seems to me to be but the one species, *A. seyal*—the alleged shittim-wood of Scripture, and the traditional "burning bush." It is quite probable that the Egyptian "Sont" is a distinct species from the "Sayal" or Seneh of the Bedouins; indeed the leafless trees I saw near Cairo were perceptibly different in habit, in the colour of the branches and the length of the spines; but in neither the eastern nor western wadies, nor at Sinai itself, could I detect the smallest variation in these respects.

So numerous are these Acacias that Wady Sâl, one of the wildest and grandest of the desert wadies, derives its name from them: in it there grows a *Lycium* (*L. spinosum*) with a lilac flower and bright scarlet berries, an Amaranth (*Ærua javanica*) with extremely woolly leaves and flower-spikes, and a curious prickly Composite (*Iphiona scabra*) which has almost the appearance of a gorse-bush, but with small, thistle-like, yellowish flowers. This wady would be a paradise for an entomologist: with the exception of the Jordan valley at Jericho, I have nowhere else seen such a number and variety of moths, beetles, centipedes, and spiders, the latter of great size and surpassing agility. I much regretted my entire ignorance of this subject.

We now have once more a glimpse of the great rocky limestone wall of the central desert, Et-Tîh, and pass through a picturesque wady with brown and red sandstone rocks on one side, and on the other huge heaps of crumbling greenstone, surely so called (like the greensand of Sussex) on the *lucus à non lucendo* principle, as they are black heaps resembling coal in colour.

We then reach the sandy plain "Debbet er Ramleh," which is in places covered with the lilac *Malcomia arenaria* and a pretty dwarf *Brassica*, for which the camels displayed great fondness; and their Arab owners darted from side to side to pluck handfuls of it, which the animals received with the greatest pleasure. In some parts of this plain, huge detached masses of orange and red sandstone rise out of the white, drifting sand on which our camels' feet fell noiselessly; and it needed no vivid imagination to see in these ruins of a former world the likeness of castles and churches in decay. We encamped near 'Ain Huderah, under an immense precipice of sandstone, at whose base was growing, out of the pure-white sand, the elegant drooping shrub *Salicornia arabica*, and the curious *Passerina hirsuta*. The next day in Wady Wetîr, a magnificent gorge between lofty cliffs of granite, we found for the first time a large shrub with oval, dark green leaves, woolly underneath, not in bloom, but recognizable as the *Calotropis* (*Asclepias*) *procera*, the Osher of the Arabs.

This evening we had our first glimpse of the Elanitic Gulf, with the mountains of Arabia beyond, lighted up by the setting sun until they more resembled a scene on the stage lighted by red fire than any natural landscape. This was followed by that exquisite after-glow, changing from blue and purple to gold and pink, and finally pale green, so unlike anything we have in our western longitudes. We were now 5500 feet lower than when at the convent; and the change in temperature was extraordinary. Our course led us for the next two days along the western shores of the Gulf of 'Akaba; and the interest of these two days, apart from the varying but gorgeous colouring of the landscape, was conchological rather than botanical. The collecting of shells in a broiling sun, and when travelling on a camel, is by no means an easy, although to me a most agreeable task, this shore being beyond all I had seen fertile in species, mostly having an Indian type, and unlike those of the Mediterranean and Northern Sea. I collected, during the two days' journey, at least 100 species, of which the following are the principal.

I append this list of shells found on the shores of the Gulf of

'Akaba, March 11–13, 1864, with great diffidence as to the complete accuracy of the species named:—

Mactra, sp.
Sanguinolaria rugosa,
Psammobia, sp.
Tellina rostellum.
Lucina tigrina.
Donax scortum.
Cytheræa meretrix.
Trigona radiata.
Circe arabica *et* crocea.
Tapes, sp.
Cardium cardissa *et* tumoriferum.
Cardita sulcata.
Arca decussata, Noæ, and sp.
Pectunculus pectiniformis.
Chama, sp.
Tridacna gigas *et* squamosa.
Modiola, sp.
Mytilus, sp.
Pinna, sp.
Avicula tarentina.
Margaritophora margaritifera.
Pecten, sp.
Spondylus gaderopus.
Ostrea, sp.
Vulsella, sp.
Lima, sp., and several others.
Patella, sp.
Fissurella, sp.
Bulla, sp.
Nerita polita, and sp.
Natica maroccana, and sp.
Ianthina, sp.
Haliotis, sp.
Tornatella, sp.
Scalaria, sp.
Solarium hybridum *et* perspectiviusculum.
Trochus Pharaonis, niloticus, dentatus *et* virgatus.
Turbo argyrostomus, and sp.
Phasianella, sp.
Turritella, sp.
Cerithium nodulosum, rugosum *et* morus.
Potamides cinerascens.
Turbinella cornigera.
Fusus colus, and sp.
Pyrula, sp.
Murex brandaris, rarispina, inflatus, and sp.
Triton anus *et* rubecula.
Pteroceras truncatum.
Strombus gibberulus *et* gigas.
Cassis turgida.
Cassidaria echinophora.
Ricinula morus.
Purpura sestum *et* hippocastaneum.
Harpa conoidalis, and sp.
Buccinum, sp.
Terebra maculata, crenulata *et* duplicata.
Columbella mercatoria, and sp.
Mitra, sp.
Marginella, sp.
Volvaria monilis.
Cypræa tigris, carneola, and sp.
Oliva, sp.
Conus tessellatus, textilis, arenatus, geographicus, tæniatus *et* araneosus.
Dentalium, sp.; and several others.

We saw on the shores of this gulf a great rarity, in the form of a man not of our own party, the only one we met with during a six days' journey; and he not only got for us some fresh fish, but also several Cypræas and Terebras alive out of the sea. The climate may be imagined from the fact that his only garment, and that of very flimsy material, was a cotton rag around his loins.

On this coast occur several trees of the Doom Palm (*Hyphæne thebaica*), peculiar as a palm on account of its numerous branches. I did not see the fruit, which is said to be eaten in Egypt, where the tree is common.

In Wady-el-Huweimirât I found a *Cassia* (*C. ægyptiaca*) and a climbing Asclepiad with white flowers (*Marsdenia erecta*, which I saw again in the Jordan valley), a small lilac *Centaurea*, *Medicago Helix* with its curious snail-like legume, and the Bitter Apple (*Cucumis colocynthis*) (of which afterwards in the Nŭhkl desert we saw numerous dry, apple-like fruits), *Ononis viscosa*, *Fagonia cistoides*, *Pulicaria undulata*, &c.

Our encampment at 'Akaba was under the shade of the palm-grove, close to the almost tideless waters of the Gulf; and the heat exceeded anything I ever experienced, being, with a north wind blowing, as high as 112° Fahr. in the shade at 1 p.m.

I must not pause to speak of the disappointment with which we learned the impossibility of proceeding *viâ* Petra, nor of the courteous, frank, and honourable conduct of the Sheikh of 'Akaba, in refusing our money, on the ground that he was unable to fulfil, as he would wish, his part of the bargain relative to our escort, but will suppose us once more *en route*, now westward, ascending the difficult pass Nŭkb, on to the limestone tableland of Et-Tîh, the central desert, towards Nŭhkl—a journey of three days, with very little to interest.

Wide, almost boundless plains of dry greyish limestone, with hardly a depression to vary the monotony, led us even to rejoice in the frequent mirage, which we saw here in perfection. In front of us appeared to extend a beautiful lake, with trees and buildings rising on its shores; at times even the ripple of its waters appeared to be visible; but, of course, as we approached it gave place to dry, hard, verdureless gravel.

March 16 was the first day since leaving Cairo on which we had seen a cloud; the morning was dull, and the dew so heavy that the outer covering of my tent was soaked with moisture. We this day saw a little grass springing, sufficient, in the slight depressions of the wadies, to give a tinge of green to the otherwise bare, dry gravel. I have seldom seen so desolate a place as Khan Nŭhkl, a halting-place on the Haj (pilgrim) road to Mecca, midway between 'Ajrûd and 'Akaba—the only place in which water is to be had at all, and what is there is indifferent and very saline. Nŭhkl stands 1494 feet above the Mediterranean.

Dry sunburnt gravel and chalk weary the eye on all sides; and

we were glad speedily to leave this place, and to welcome even the verdure of a thick but low growth of olive-green and reddish *Salicornia*. Turning once more northwards towards Palestine, in the evening the air was again fragrant with *Mathiola odoratissima*.

March 18.—We crossed dry chalky plains, covered with flints of a brown colour. The mornings were now very cold, and the middle of the day scorchingly hot, but quite free from the oppressive heat of 'Akaba. We encamped in the evening near Gebel 'Ikhrimm, in the midst of more vegetation than we had seen for several days. I found here the curious *Anastatica hierochuntica*, both as a dry "Rose of Jericho" of full size, withered and blown about by the winds, and also as a young seedling of a couple of inches across, just beginning to flower. *Pulicaria undulata*, an *Oligomeris*, a *Reseda*, a *Blitum*, a small *Linaria* with yellow flowers, and a number of pretty Papiloniaceæ were growing here, all dwarf. A very small *Astragalus* with fine silvery foliage and white flowers, and another species with yellow flowers and long hoary leaves (which is, I believe, *Astragalus Vanillæ*), *Trigonella indica* with yellow flowers, and another *Trigonella* with white and pink flowers, an exquisite little *Lotus* (*L. pilosissimus*), *Anthyllis sericea*, another silky-foliaged plant, and one or two species of *Medicago*, with the curiously podded *Hippocrepis multisiliquosa* and *Herniaria hirsuta*, grow here in profusion. We saw many large Cranes, with red legs and wide-spread wings of white and black; and this evening there were near our encampment several large, very handsome Vultures, not the dirty-looking birds of Egypt. I think they were of the *Vultur fulvus*, the Griffon species. The same character of monotonous dry chalky plains and dry wadies accompanied us all the way to 'Abdeh, where we encamped in a plain bounded by swelling hills of less harsh and angular form. Some grass, too, now began to appear, and gradually increased. We had not, however, yet left behind the *Salicornia*, which was in places covered with a small white *Helix*, having at a distance the appearance of flowers.

The next day, passing Ruhaibeh, with traces of an ancient town (probably Rehoboth), and seeing some small attempts at cultivation, grain (barley) growing in some of the wadies, we encamped in the midst of rounded hills on all sides covered with grass, to us a strange sight, which gave me an idea of an American prairie—without a tree, without a bush, not one distinctive feature to mark our course. Our Arab guide lost his way, and we encamped in doubt as to our exact whereabouts.

While the tents were being erected the camels were, as usual, turned out loose, here indeed to graze on the abundant herbage, and not, as previously, merely to browze on stray shrubs and herbs, which latter, however, they decidedly prefer. I, when botanizing at a little distance, saw them all right; but as I was afterwards busy in my tent, putting the plants I had found into my press, I was informed that two of our baggage-camels had been stolen. I only mention the incident in this place, to be able to add the fact, that when the Bedouin who had stolen them was found, and heard that they were conveying the baggage of *English* gentlemen to Hebron, he at once restored them on that very ground—our nationality,—another proof of what I observed throughout the tour, the good feeling of the Arabs towards the English.

The next day, as we approached Bir-es-Seba (Beersheba), the fertility of the country rapidly increased, and with it the variety of plants in flower.

Malvaceous plants, hitherto I may say almost entirely absent, now became conspicuous. *Malva sylvestris* of great luxuriance, *Malva crispa*, and *Malope trifida* with the brilliant yellow of *Chrysanthemum coronarium*, a very dwarf purple *Scorzonera*, and a bright blue *Anchusa*, gave a garden-like aspect to the ground. We twice saw here a greyish-brown spotted snake, about three feet long (*Cerastes Hasselquistii*), the Horned Viper, or Asp of Cleopatra, a very venomous species according to the Arabs, who cut them in two with their swords,—and also a more pleasing reptile, a pretty young land-tortoise (*Testudo græca*), which I brought alive to England.

One of the loveliest plants growing in the grassy country was a brilliant blue Amaryllid (the *Ixiolirion montanum*), so fragile that it was almost impossible to preserve it for drying. *Lotus arabicus*, with very downy leaves and claret-coloured flowers, *Onobrychis trilophocarpa*, having prickly pods, and a large thistle-like *Eryngium*, with brown and yellow flowers, the beautiful *E. amethystinum*, with its globes of blue flowers, were amongst the more noticeable plants. Of Grasses, I remarked *Phalaris minor*, *Festuca divaricata*, *Ægilops ovata*, *Schismus marginatus*, *Polypogon monspeliensis*, a *Kœleria*, and a large-growing *Stipa*.

The following evening we rested in the midst of a vast undulating plain of rich, thick grass, brilliant with scarlet *Ranunculi* and *Adonis æstivalis*, and where we first saw a lovely little creeper, *Paronychia argentea*, whose silvery bracteæ often afterwards lent a charm to the most barren rocks in the wilderness of

Judæa. The pretty *Iris Sisyrinchium*, which we first saw at the Pyramids, again pleased the eye and perfumed the air.

Numerous troops of camels were grazing on this rich pasture; and the prairie was dotted with flocks of sheep and goats, and with the black tents of the Bedouin flock-masters. Our own camels ate very sparingly of this rich grass, evidently preferring the dry, thorny herbage of the Sinai desert.

One of the most curious sights I witnessed during the journey was an Arab encampment which we visited this evening, where we saw the 2000 camels belonging to the tribe, which nightly return to and are tended within the encampment. They lie in front of their owners' tents, and, being very timid, are at once aware of the presence of strangers, and give loud tokens of their disapproval by groans. Their rest was disturbed by our visit, and I heard them keep up low moans until daybreak. They are as sensible as watch-dogs to a strange foot, voice, or even inaudible presence. It was still more strange, about 6.30 a.m. the next day, to see the troops of camels disperse: radiating from the encampment like the spokes of a wheel, they filed across the apparently boundless prairie in single lines, young and old, patriarch and suckling, of about 100 in each troop.

Having crossed the dry bed of the watercourse near Beersheba, we were now within the frontier of Palestine, and my desert notes should here, by right, end; but I find, on inquiry, that a very great difference exists in the flora of Palestine at various seasons of the year; and it may therefore not be without interest, to some, to read brief notes of the plants remarked by myself in the months of March and April.

I had been led to believe I should find many bulbous plants; I hardly found any. I expected to see several Orchids; I found them of unfrequent occurrence, and few species. The general character of the vegetation of Palestine proper (excepting the Jordan valley) seemed greatly to resemble that of Sicily and Greece. We had observed, since leaving Nŭhkl, the gradual improvement in fertility of the country; and we now, on approaching Dhoherîyeh, saw the richest flora observed during the journey. We soon entered a picturesque gorge at the southern limit of the hill-country of Judea, and were gratified by the sight of a herd of gazelles scampering gracefully along the hill-side. The following are a few of the more conspicuous plants noticed in this vicinity:—*Anemone coronaria* and *A. hortensis*; *Ranunculus asiaticus*; *Adonis æstivalis*; *Convolvulus althæoides* and *C. sagittæfolius*;

Salvia, two or three species; *Malope* and *Malva* in profusion; *Iris*; *Sisyrinchium*; a very few scarlet Tulips (I believe; the bloom was over here. I was told that, a week before, they abounded between Jaffa and Jerusalem).

Amongst the rocks were Cyclamens (*C. latifolium*, white, *C. repandum*, red) of every shade of pink, lilac, and white, blooming profusely. The greatest novelty, and one of the loveliest plants, was the *Linum Sibthorpianum*, which grew about a foot or so high, covered with large-sized flowers of a deep pink, which, when fading, verges to lilac. This plant, with Cyclamens, *Ranunculi*, and the *Paronychia*, was the commonest flower around the Holy City. Here too we found *Hippocrepis multisiliquosa*, *Echium italicum* and several other blue-flowered Boragineæ, a blue *Scabiosa* very like our own *S. columbaria*, and several species of *Trigonella* and *Medicago*, *Erodium malacoides*, *Lathyrus cicera*, *Coronilla glauca*, and *Pisum arvense*. Between Dhoherîyeh and Hebron we welcome some scattered trees on the hill-sides, a few olives, *Ceratonia siliqua*, *Pistacia terebinthus*, &c.; on the hill-sides, too, are thickets of the prickly oak (*Quercus pseudococcifera*)*, which reaches its fullest development in the great oak of Mamre, near Hebron: here on the hill-sides it is a thickly leaved bush; the foliage far more prickly than when fully grown. Many other shrubs are found in the thickets, as *Arbutus andrachne* and, I think, *A. unedo*, *Pistacia lentiscus*, *Passerina hirsuta*, *Cistus creticus*, *Alhagi Maurorum*, several species of *Genista*, *Coronilla*, and *Cytisus*; whilst the more exposed hill-tops are covered with a dense growth of *Poterium spinosum*. From under almost every bush, from out of every crevice in the rock, peers the lovely *Cyclamen latifolium*, and in the open grassy spaces the tall and elegant spikes of *Asphodelus ramosus* and *A. luteus*; the same plants, in less abundance, are seen north of Hebron, on the way to Jerusalem.

At Hebron we see the fig- and olive-gardens, and the vines of Eshcol, which are now (March 23) just beginning to push out their young shoots.

Great and numerous as are the attractions of Jerusalem, and limited as is the period spent there by most travellers, little time is found for botanizing in its neighbourhood; but amongst the plants I found during my walks and rides were *Hyoscyamus aureus*, a common weed, growing even on the walls of the church of the Holy Sepulchre, together with the omnipresent wall-plant

* See Dr. Hooker's art. on Oaks of Palestine, Linn. Soc. Trans. vol. xxiii. p. 381.

(*Parietaria officinalis*),—on the city walls, in addition to the above, *Capparis spinosa*, a half-shrubby *Phagnalon*, *Pistacia lentiscus*, and *Valantia muralis*,—on the waste ground of Mount Zion several Echiums, a smaller species of *Paronychia* (*P. capitata*), as well as *P. argentea*, various *Onosmæ*, *Lycopses*, *Cynoglossi*, and other Boragineæ, *Torilis trichosperma* and *Psoralea bituminosa*,—on the Mount of Olives, in addition to these, *Anemone coronaria* and *Ranunculus asiaticus*, *R. myriophyllus*, *Adonis flava*, *Althæa acaulis* (a pigmy hollyhock most abundant in stony places), *Erodium ciconium*, several *Malvæ* and *Malopes*, *Gnaphalium crispatulum*, *Vicia bithynica* and *V. syriaca*, *Anthyllis tetraphylla*, *Fumaria parviflora*, *Ononis hispanica*, *Celtis australis*, and *Cratægus aronia*. On the olive-trees, both on Mount Moriah and the opposite hill, was growing a *Viscum* (I believe, *V. cruciatum*), and I think I saw it also growing on *Celtis australis*.

As regards Ferns, *Adiantum capillus-Veneris* grows abundantly at the Pools of Solomon, and in an old well on the Mount of Olives very luxuriantly, also at Aceldama; *Ceterach officinarum* on rocks and walls near Bethlehem; and *Cheilanthes fragrans* in profusion at Beit Jala, and in the valley of Hinnom, near Enrogel. *Notholæna lanuginosa* was found by the Rev. H. Gepp on rocks between Jaffa and Jerusalem.

There is a fine botanical harvest to be reaped on the south-east of Jerusalem. As I passed through Bethany, the pomegranates were very beautiful, their young bright-red shoots contrasting with the green of the almond-trees, now bearing their woolly green pods, extensively used as food in this unwholesome state. At Mar Saba the pomegranates were in bloom. Leaving Bethany I saw *Nasturtium officinale*, as at Bethlehem, Jenin, Nazareth, &c. For a couple of miles or so beyond Bethany wheat is cultivated, and the hill-sides are now green with corn shooting into ear; but after that, all is in the wildest, most desolate state of nature, with scarcely a bush or plant of any size. Midway to Jericho I remarked *Verbascum plicatum*, *Convolvulus dorycnium*, *Mesembryanthemum crystallinum*, and *M. nodiflorum* growing on the dry stony ground, which seemed a fitting refuge for the grey snakes (*Cerastes*) and lizards which there abounded; amongst the latter was, I think, the Chameleon (*Chamæleon vulgaris*).

Sudden indeed is the change from the barrenness of Wady Kẹlt to the jungle on the banks of the brook Cherith, and the dense mass of vegetation nourished by its waters and by those of the delicious tepid spring 'Ain-es-Sultân (which is the fountain

healed by Elisha). Its limpid stream is overhung by a fine wild fig-tree (*Ficus carica*); but its waters are soon lost in a semi-tropical thicket of *Arundo donax*, *Solanum coagulans* (bearing at once its dull purple flowers and its yellow apple, once thought the Apple of Sodom), *Physalis somnifera*, a tall *Pluchea* (?*P. Dioscoridis*), six or seven feet high, and Althæas of gigantic size. The open, drier ground above the spring has thickets of our old Feirân friend, *Zizyphus lotus*, with ripe fruit, and on its branches, growing in pendulous tufts, the lovely epiphyte *Loranthus indicus*, with scarlet blossoms now almost over, but, even in its present state, one of the most tropical-looking plants I have seen. Here, too, are many struggling spiny trees of *Balanites ægyptiaca*, hardly yet in leaf, but bearing many green fruit, in size, form, and colour resembling a large unripe plum; it is the "Zukkum" of the Arabs, and yields the straight, yellow wands so much used for walking-sticks by the wood-turners of Jerusalem, who call it balsam-wood, and who inscribe upon the articles made from it the Hebrew word "Jordan." At this place, too, we see again the white flower of the *Marsdenia*, with the *Zygophylleæ* and *Fagoniæ* of the desert, *Hypecoum imberbe*, and *Cicer arietinum*, the last possibly an escape from cultivation.

Descending to the very banks of the Jordan, we have tall Poplars (*Populus euphraticus*), elegant Willows of most luxuriant growth, the acacia-like *Prosopis Stephaniana*, and Tamarisks now in full flower. On the salty soil near the Dead Sea we have some very curious plants—as *Echinopsilon eriophorum*, growing in patches which are quite white, so thickly is it covered with a cottony down; *Pteranthus echinatus*, a Knotwort in habit resembling a dwarf Umbellifer; several Salsolas, Suædas, and *Atriplices*; *Statice ægyptiaca*, with white, and another species (*S.* ? *spathulata*) with pinkish-lilac flowers, and thickets of *Arundo donax*. The only other uncommon plant which I collected on my way back to Jerusalem was a pale straw-coloured *Chardinia*, near Mar Saba; but I remarked *Ferula nodiflora* on rocks in Wady en-Nâr.

Leaving the Holy City for the north, I may note,

Gladiolus segetum, *Linum flavum*, *Campanula speculum*,	at Neby Samwîl.
Sherardia arvensis, *Centaurea cyanus*, *Bupleurum longifolium*, *Jasminum fruticans*,	near Bethel.

Cheilanthes fragrans,
Astragalus of the "*hamosus*" group,
Campanula pentagona,
Hymenocarpus circinatus,
Lagœcia cuminoides,
Polygala anatolica, and the curious
Callipeltis cucullaria,
} near Nablûs*.

The place of the pink *Linum Sibthorpianum* is now, in central Palestine, taken by *Scabiosa prolifera* (a dwarf, most abundantly flowering, yellow species), *Cistus creticus*, and *C. salvifolius*. On the Plain of Esdraelon grew chiefly enormous *Cynaræ*, *Cardui*, and other large Composites not yet in flower.

Near Nazareth the most noticeable plants were the elegant white-flowered Umbellifer *Artedia squamata*, and the tall and handsome *Althæa ficifolia*.

On Mount Tabor the only flowering plant, save the Cyclamens, was *Styrax officinalis*, which at the time of my visit (April 13) was most lovely with its innumerable white flowers, in appearance and fragrance not unlike orange-blossoms. Here and on the hills of Galilee I was pleased to see really fine trees of *Quercus Ægilops*, *Pistacia terebinthus*, as well as large shrubs of *Cratægus aronia*, *Cercis siliquastrum*, and *Paliurus aculeatus* (which now takes the place of the *Zizyphus*).

At Tiberias, in the deep Jordan valley, we again meet with a semi-tropical flora in the *Zizyphus*, *Zygophyllum*, and *Indigofera*; whilst the shores of the Sea of Tiberias are fringed with Oleanders, now coming into full beauty. In its waters I found the pretty shells *Neritina Jordani* and *Melanopsis costata*.

Overtaken, near Safed, by the latter rains, we were thoroughly drenched, and ourselves and (what I think I thought almost as much of) our dried plants were immersed in the waters of the Barada, which completely overflowed the track at Sûk, to the great damage of those more recently collected, including

Laurus nobilis,
Vitis vinifera,
Adiantum caput-Veneris,
Nerium oleander,
Tribulus terrestris,
Pennisetum, sp., and
Lastræa filix mas†,
} from Banias,

* The Rev. H. Gepp found *Gymnogramma leptophylla* on Mount Gerizim.

† Making in all *six* species of Ferns seen in Palestine.

and some exquisite yellow and red *Ranunculi* from Kefr Hauwâr, near Damascus.

Of the flora of Anti-Lebanon and Lebanon itself I saw nothing. Snow, rain, wind, and mist prevailed during our stay in that region—the only bad weather we experienced during our journey.

I will therefore conclude with the wish that any reader of the above notes, contemplating such a journey, may be blessed with as good health, and may receive as much real enjoyment from it, as did at the time, and still does, the writer.

On a new Dye-wood of the genus *Cudranea*, from East Tropical Africa. By JOHN KIRK, M.D., F.L.S.

[Read March 2, 1865.]

WHEN on the Zambesi, at the village of Sena, my attention was first drawn to a climbing shrub of the genus *Cudranea*, whose edible fruit had somewhat the flavour of an insipid custard-apple. The near botanical affinity between this and the fustic dye-wood led me to inquire after its stem. Difficulty was found in obtaining specimens of sufficient thickness; however, after some search, a piece with mature heart-wood of an inch diameter was procured. This, with cloth previously mordanted in alum, gave a light-yellow colour, which resisted the action of soap. Although convinced of the value of this dye, the small size of the bush on the Zambesi classed it among the curiosities of science of no commercial value. I was therefore pleased, on a visit to the Rovuma, to find this plant, eight degrees nearer the equator, a large shrub, whose thick stems entwined the forest-trees, and contained a cylinder of deep red heart-wood, 5 inches in diameter. Specimens were brought home, from which the present report has been made by one practically acquainted with these matters.

Our examination of the Rovuma was strictly limited to the valley. If this plant be as abundant and equal in size on the tableland (200 feet elevation) as in the valley, its collection would be to the natives a matter of some importance.

As before said, the plant is a *Cudranea*, and, I believe, an undescribed species. The bark of the old stems is thick; it consists of many layers, deeply rent longitudinally. The inner bark and white wood abounds in a yellowish milky juice: the heart-wood is of different shades of red, very heavy, and full of pores.

The small branches are armed with strong spines, each bearing a few leaves; these are shining, ovate or oblong.

The heads of male flowers are the size of a pea, white, and deciduous; the female form a compound fruit, the size of a walnut, uneven on the surface, of a yellowish cream-colour, with seeds imbedded in an agreeable pulp. By the natives of Sena it is named "Pambuku." Specimens of plant and wood are in the National Herbarium at Kew, also at Edinburgh.

The following is the report obtained for me by James Young, Esq., of Limefield:—

"I have just got the report upon the sample of wood. It gives a colouring-matter somewhat between quercitron-bark and fustic. There was not sufficient to make as many trials as they could have wished; but it would be worth at this time £6 10*s*. per ton.

"Quercitron-bark at present is £7, and fustic £6 per ton.

"A ton of the wood would be required to ascertain properly its worth.

"Messrs. Harter will give above price for a ton, and afterwards give full reports upon it.

"It might of course be more valuable than either bark or fustic, when tried on a large scale.

(Signed) "JOHN THOM."

On the Palms of East Tropical Africa.

By JOHN KIRK, M.D., F.L.S.

[Read March 16, 1865.]

THE Palms of the lands lately explored on the Zambesi, Nyassa, and Rovuma are few in number; they belong to the six genera *Cocos*, *Elæis*, *Phœnix*, *Borassus*, *Raphia*, and *Hyphæne*.

In no other group of plants is the difference which exists between the flora of the African continent and the adjacent islands of Madagascar, the Mascarene, Comoro, and Seychelles more marked than in this; and none illustrates better the uniformity of vegetation over the whole of that continent itself within the tropics.

1. COCOS NUCIFERA, *L.*

On the Mozambique coast the cocoa-nut is grown; but nowhere in that district is it an object of commercial importance.

Further north, within the dominions of Zanzibar, it is extensively cultivated.

On the sea-board, and throughout the Zambesi delta, the Palm is planted near the residences of Europeans, but not in any quantity. Beyond 60 miles inland it is extremely rare, although I am acquainted with a few trees which bear fruit a little above the town of Tete, on the left bank of the Zambesi, and distant from the sea 300 miles. It is unknown in the interior, on the Nyassa Lake or on the Rovuma.

2. Elæis guineensis, *Linn.*

This Palm has hitherto been known from the western side of the African continent, that from America being a distinct species.

The specimens now brought from the central lakes of tropical Africa are not so perfect as might be wished. Although no character has been found by which to distinguish this from the common Oil Palm of the west, it is not improbable that further research may establish a difference; meanwhile they must be regarded as one.

Major Gamitto ('O Muata·Cazembe,' p. 359) has informed us that the people of Cazembe use, in cooking, an oil made from the nuts of a Palm named "Coma."

The town of Cazembe is situated on the border of a lake fed by the Loapula, whose waters probably fall into the Tangenyika Lake, on the eastern shore of which Capt. Burton ('Journal of Royal Geographical Society') found large quantities of palm-oil exposed for sale.

Captain Speke makes no mention of this palm on the Victoria Nyanza, or in the region he traversed. Having formerly accompanied Captain Burton to the Tangenyika, had this tree existed he must have recognized it; we may therefore suppose that it is absent from that route. At the same time it certainly exists to the south of Gondokoro, its fruit having been found attached to native girdles brought home by Dr. Murie. These may have come from the country of the Luta Nzige.

The Oil Palm was first seen by us on the western shore of the Nyassa Lake, in lat. 12° south. As we sailed north on that inland sea it became more frequent, but was nowhere an object of importance to the tribes, as it would seem to be on the shores of the middle lake and its affluents, according to Gamitto and Burton.

Seen from a distance, the full-grown Palm has much the appearance of a Date, having a clean cylindrical stem, 30 feet high, topped

with a crown of feathery fronds. The dense clusters of male and female flowers hang down from the base of the leaves, in part concealed among them.

The fronds are long and pinnate, the lower pinnules being spinous and seated on a swelling where they join the rachis. A close comparison of male and female spadices from which the flowers had fallen, shows no difference between this and *Elæis guineensis*. The fruits brought from Nyassa are small; but some of the Oil Palms of the west yield very diminutive nuts also, while the specimens of Dr. Murie from Gondokoro are larger.

As yet the *Elæis* is known from the lake-regions on the eastern side of Africa, and not from the sea-coast. Its geographical limits seem to be 3° N. lat. and 12° S.

3. Borassus flabelliformis, *Linn.*

The older authors, as Linnæus, Schumacher, and Thonning, regarded the Indian and African *Borassus* as one species. Martius, who had no means personally of making observations, separated that of Africa under the name of *B. Æthiopum*, in consideration of having fewer flowers in each catkin of the spadix, of its swollen stem, and, above all, its geographical position.

In the first of these he is mistaken; the African *Borassus* possesses as many flowers as the Indian. Thonning, whom he quotes, may have examined a spadix from which some of the flowers had fallen. The swelling of the stem is seen in many palms, and is a character of uncertain meaning: if constantly present, it would be of importance; but in *Borassus*, although usual, it is far from universal.

As to geographical position, this must be excluded, so many African trees are now found in Asia. The Tamarind is an instance of an African forest-tree having been taken to India; and, for all we know, the Fan-Palm may have migrated also.

B. flabelliformis is widely diffused over tropical Africa. It is the Deleb of Nubia, and its swollen trunk may have suggested to the old Egyptians the bulged shaft of the columns. It is found in Senegal. Vasco da Gama saw it at Mozambique, and Loureiro noticed it at Melinda. On the Zambesi it is very common in the flat alluvial lands; but from the upper parts it is absent, until we ascend to the junction of the Loeti and Leambai, in lat. 14°, in the centre of the continent. On the Nyassa Lake it is seen, and is common on the Lower Shiré and Rovuma.

Wherever it occurs, whether singly in a forest or as a monotonous plantation covering miles of flat land to the exclusion of other

trees, it is always a marked feature in the landscape. It is the largest of East African palms. On the Zambesi it attains a height of 80 feet, but is more commonly under that; such a tree at 5 feet above the ground has a girth of 5 ft. 11 in.

The ventricosity on the stem most commonly takes place from 35 to 40 feet up; although frequent, it is not a constant character; it seems to mark the first flowering of the plant. In another African palm, viz. a new species of *Hyphæne*, the same phenomenon is seen in the islands above the Victoria Falls.

The thickest part of each Borassus is at the ground; it quickly diminishes in the first five feet as we ascend, reaching the minimum girth at 20 feet, above which it again thickens towards the ventricosity.

The following are measurements of a palm in which the swelling had fully formed:—

	feet.	in.
Height from the ground to base of fronds	40	0
" " to centre of ventricosity .	35	0
Circumference at the ground	7	5
" 3 feet above the ground	5	8
" 20 " "	3	7
" 35 " "	4	4
" 40 " "	3	6

The wood of the Borassus is hard outside, soft and pithy within; when kept dry it is durable and resists well the attacks of Termites. The frond when split up is sometimes platted and made into hats, but it is brittle; for cordage it is wholly unsuited, the various Hyphænes being employed.

By negroes and elephants the fibrous outer coat of the fruit is sucked: it has an agreeable smell, fine orange-colour, but a mawkish, insipid taste. The gelatinous interior of the albumen is eaten, and the young shoot cooked as a vegetable and esteemed both by natives and Portuguese. Palm-wine is got from this, as from others, by cutting the fronds and daily taking off a thin slice from the end of the bud, keeping it the while shaded from the sun.

4. Phœnix dactylifera.

This palm is not native of the country, nor can it be said to be introduced. At Mozambique there are examples. On the Zambesi there is one solitary tree outside the stockade of Sena, with stem about 20 feet high, entwined with a climbing fig.

The Portuguese maintain that this tree has borne fruit. It is just possible it may have been fertilized by the ***P. spinosa***, growing

close to it. There is no other of its like in the country within several hundred miles. From the root there are many young plants coming up.

5. PHŒNIX SPINOSA, *Schum.* and *Thon.*

Common over the central regions of the continent and on the coast, both as a bush and a tree with flexuose stem 20 feet high. The green bunches of fruit, if immersed for twelve hours in water, suddenly assume a rich scarlet hue, and the astringent pulp becomes sweet.

The split leaf is made into fine mats and caps, which take colour easily, and are worked of many patterns.

6. RAPHIA VINIFERA.

This was not seen by us near the coast. It occurs south of the Zambesi, in the mountains of Gorongozo; and in the hilly regions south of Nyassa, near streams. It is not known in the country near the Victoria Falls.

HYPHÆNE.

This genus is difficult to subdivide into satisfactory species. In some trees we have the stem dichotomously branched as in the Doum of Egypt, in others cylindrical throughout, in others ventricose. These differences are accompanied by others, in the forms of fruit and ligule, which are local; but the intervening districts yield forms also intermediate.

I have endeavoured to reduce the number of species as far as possible; the following table shows their leading characters:—

TABLE OF THE ZAMBEZI HYPHÆNES.

	Stem.	Fruit.	Ligule.	Locality.
1 Hyphæne coriacea, *Gaert.*	dichotomous.	pyriform.	oblique.	maritime.
2. " crinita, *Gaert.*	cylindrical.	oblong.	equilateral.	inland.
3. " ventricosa, n. sp.	ventricose.	unilspherical.	ateral.	central.

Hyphæne Thebaica differs from *H. coriacea* in the form of its fruit, which is larger at the base than at the apex. The new species, with small globular fruit, brought from central Africa by Capt. Grant, has not yet been described, but will stand between *H. coriacea* and *H. crinita*.

7. HYPHÆNE CORIACEA, *Gaert. Fruct. et Sem.* i. p. 28.

"Caudice ramoso, drupa turbinato-pyriformi; vertice planiusculo, medio constricto." *Martin's Hist. Nat. Palm*, vol. iii. p. 227.

This is the dichotomous palm of Eastern Africa common to the maritime region. There are two varieties, the

1st with stem 30 feet high, many times divided; fruit smaller and less flattened than in the second: observed on the Rovuma, between eight and twelve miles from the sea-coast. The

2nd is a smaller palm, seldom divided more than once, and often a bush with very short stem; the fruit much flattened at the end, and of a deep brown colour. It grows abundantly at the Zambesi mouth.

8. Hyphæne crinita, *Gaert. Fruct. et Sem.* ii. p. 13.
Hyphæne natalensis, Kunze.
„ *Petersiana*, Klotzsch.

This palm is not found on the sea-coast; two hundred miles up the Zambesi it is common, also at the south end of Nyassa, and on the river Shiré. On the hills it is less frequent. The stem is 20 to 30 feet high, more or less flexuose or erect. Fronds large, the ligule well marked and nearly equal on both sides. Fruit ovate or oblong, larger than that of *H. coriacea.* Elephants sometimes swallow it; but by men it is seldom eaten.

9. Hyphæne ventricosa, nov. sp.

This palm is very distinct from either of the above. It was seen by us on the low rocky islands above the Victoria Falls of the Zambesi, and is well represented in an oil painting of that scene by Thomas Baines.

From other *Hyphænæ* it is known by its loftier stem, which is often swollen in the middle like that of *Borassus*—and by its spherical fruit surrounded by a considerable quantity of farinaceous matter, and larger than that of either of the preceding.

I believe that this species extends south to the Lake Ngami. By the Makololo it is named "Mokolwane."

Notes on a Collection of *Algæ* procured in Cumberland Sound by Mr. James Taylor, and Remarks on Arctic Species in general. By G. Dickie, M.D., F.L.S.

[Read June 15, 1865.]

Cumberland Sound is an arm of Davis Strait, on the west side, commencing about lat. 65° 10′ N., and long. 64° 40′ W. In length it is about 90 miles, by 30 in breadth; many small islands are scattered along its shores, which are deeply indented by numerous

bights. Of late years it has been much frequented in search of whales; and parties pass the winter with the view of capturing these animals during the spring and early part of summer. The Kikerton Islands near the head of the sound, and not far from the most north-eastern part of its shore, are the headquarters of the whalers.

The rise of tide is much greater than in the main strait, being reported as amounting to 30 feet, and forming a "bore," whereas in the open strait it is 6 to 7 feet.

The upper part of the sound abounds in animal life of all kinds; and some of the *Algæ* occur in great profusion, and of large size.

Mr. James Taylor, in medical charge of a whaling-vessel, during a visit to the sound, at my request, made collections of *Algæ*, as well as of other Cryptogamia. A notice of his observations may possess some interest, more especially because, so far as is known to me, no collections have previously been brought from that quarter.

In the first place, I may note here the results of some observations on temperatures of the air and of the sea at the surface, from records made in the sound during the whole of August, and from 1st to 9th of September, in 1861. The mean temperature of the air during the forty days was 35°·5 F., that of the sea 32°·7 F. These records were made when the ship was in the pack-ice: on the land and in water near the shore the results would doubtless have been very different, especially at an earlier part of the season.

Series I. MELANOSPERMEÆ.

Fucaceæ.

Fucus vesiculosus, L. In great abundance, and varying much in size—the smallest not exceeding two to three inches in length, and proportionally narrow; the variety without vesicles most common.

F. nodosus, L. The specimens are smaller and more slender than the British form, and the receptacles, instead of ovate, are spherical.

Sporochnaceæ.

Desmarestia aculeata, Linn. A slender form, 6 to 7 inches long, and sparingly branched.

Laminariaceæ.

Agarum Turneri, P. & R. This remarkable plant is in great abundance, and marks the upper limit of the Laminarian zone, taking the place which *L. digitata* occupies on British shores. A suite of specimens at different periods shows that the frond is in the earlier stages broadly linear, then linear-lanceolate, next cordate-lanceolate, and finally cordate and cordate-ovate. The midrib is obvious at a very early stage, even when the plant is but half an inch long; the holes appear at a later period: I possess specimens four inches in length, which have nearly assumed the outline of the mature frond, and yet no trace of holes.

Laminaria longicruris, De la Pyl. This remarkable species is in great profusion. Mr. Taylor reports having seen specimens in the sound which measured upwards of 80 feet, stem and frond together.

L. saccharina, Lam. Not so plentiful as the last.

L. fascia, Ag. All the specimens are of the narrow variety, 6 to 12 inches long, and a quarter of an inch in breadth.

Dictyotaceæ.

Dictyosiphon fœniculaceus, Grev. Seems to be not uncommon, but very small.

Chorda lomentaria, Grev. From 4 to 6 inches in length.

Punctaria plantaginea, Grev. Is probably rare; only a single specimen procured, length 4 inches.

Chordariaceæ.

Chordaria flagelliformis, Ag. Not uncommon; small, branches fine and distant.

Ralfsia deusta, C. Ag. Adhering to rocks and stones.

A curious variety of this species forms a thin dark-olive crust on the terminal spires of littoral Mollusca (*Buccinum*, *Littorina*, and on *Lottia*; the movements of the animals and consequent friction to which the plant is exposed prevent its full development.

Elachista fucicola, Fries. Parasitical on *Chætomorpha*, *Melagonium* and *Desmarestia aculeata*. I can find no essential difference between the specimens from Cumberland Sound and British specimens, the former being merely smaller.

Ectocarpaceæ.

Chætopteris plumosa, Lyngb. Smaller and less branched than British specimens.

Sphacelaria arctica, Harv. This species appears to be not uncommon, rooting among stones between tide-marks. It was first described by Professor Harvey, from specimens without fruit, gathered by Dr. Lyall at Disco Island, on the east side.

S. cirrhosa, Ag. A single specimen, growing on *Ahnfeldtia plicata*; appears identical with the British form.

Ectocarpus littoralis, Harv.* Common along the shores of the sound.

Series II. RHODOSPERMEÆ.

Rhodomelaceæ.

Odonthalia dentata, Lyngb. Smaller and narrower than the British form, but certainly identical. Rather rare.

Rhodomela subfusca, Ag. Smaller and less branched than usual. Frequent.

Polysiphonia arctica, J. Ag. Has the general habit of *P. urceolata*, but differs in structure, there being seven siphons, while *P. urceolata* has four. This species is not unfrequent along the shores, with *Callithamnion Americanum*, Harv., on the lower surface of large boulders, where both are protected from the grinding of the ice.

Rhodymeniaceæ.

Euthora cristata, J. Ag. Usually small, not exceeding two inches; growing on *Halosaccion ramentaceum*.

Rhodymenia palmata, Grev. Abundant, large, and often proliferous.

Cryptonemiaceæ.

Ahnfeldtia plicata, J. Ag. Abundant.

Kallymenia Pennyi. Harv. Usually in deep water.

The outline varies according to age, young plants being broadly and obtusely lanceolate; old plants are obovate, gradually taper-

* *E. littoralis*, L., is stated by Prof. Agardh to be distinct from the British species of that name, which he calls *E. firmus*.

ing into a short footstalk. The specimens from the sound are much smaller than those which were dredged by Dr. Sutherland and by Dr. Walker in the main strait.

Halosaccion ramentaceum, J. Ag. Not uncommon. Specimens small, not exceeding four inches, and sparingly branched.

H. dumontioides, Harv. First described by Prof. Harvey, from specimens found by Dr. Lyall in lat. 76° N. Mr. Taylor's plants do not exceed four inches in length, Dr. Lyall's reaching twelve or more.

Ceramiaceæ.

Ptilota serrata, Kütz. Rather common.

Callithamnion Americanum, Harv. Abundant on the lower surface of large boulders between tide-marks. Attains three inches in length. Dr. Walker's specimens, growing on *C. melagonium*, from Port Kennedy, are much smaller.

C. sparsum, Harv. Occasionally upon *Sphacelaria arctica*.

C. Rothii, Lyngb. Frequent in the sound, in the form of fleecy tufts two or three inches long. British specimens vary from a line to half an inch; this contrast as to size is the only respect in which the plant differs from the British form. Professor Harvey agrees with me as to the identity.

Series III. CHLOROSPERMEÆ.

Ulvaceæ.

Ulva latissima, L. Common.

Enteromorpha intestinalis, Link. Frequent, but very dwarf.

E. clathrata, Grev. Various localities on the shores of the gulf.

E. compressa, Grev. Not unfrequent.

Ulva latissima, L. Common.

Confervaceæ.

Cladophora arcta, Kütz. Common.

C. lanosa, Kütz. Frequent on other Algæ.

Rhizoclonium riparium, Kütz. Not uncommon on the shores.

Chætomorpha melagonium, Kütz. Common.

C. tortuosa, Kütz. Shores of Kikerton Islands.

Oscillatoriaceæ.

Calothrix pilosa, Harv. Shores of Kikerton Islands.

Oscillatoria —— ? Fragments too imperfect for recognition; Fresh water.

Nostochineæ.

Nostoc arcticum, Berk. Various parts of the shores of the gulf.

It may be of interest to add here a list of other species of *Algæ* which have been met with at various times by different observers beyond lat. 60°,—gleaned from various works*.

Fucus distichus, L.

Fucus serratus, L.

Alaria Pylaii, Grev. This plant is abundant in various parts of the Arctic sea, and attains a large size. In some specimens which I possess, the fruiting leaflets scarcely differ in form from those of *Alaria esculenta* of our own coasts.

Laminaria digitata, Lam.

Asperococcus echinatus, Grev.

Myrionema strangulans, Grev. I possess specimens of *Chætomorpha melagonium* covered with a minute parasite, agreeing in structure with the genus *Myrionema*, and, so far as I can judge, identical with the British plant.

Elachista flaccida, Aresch. Parasitical on *Desmarestia aculeata*, differs slightly from the British species in length of joints.

Ectocarpus Durkeei, Harv.? The specimens dredged in Davis Strait are fragmentary, I therefore mark the species as doubtful; on some the fruit agrees with the figure in 'Nereis Boreali-Americana.'

Rhodomela Lycopodioides, Ag.

R. gracilis, Kütz.

Polysiphonia urceolata, Grev.

Corallina officinalis, Lam.

* Harvey, 'Nereis Boreali-Americana;' Agardh, 'Species Algarum,' &c. &c.

Melobesia polymorpha, L. I possess fresh shells of *Mytilus edulis* completely encrusted with this species; flat stones from the same locality present a similar crust at the edges, in the centre rising into rounded dichotomous obtuse branches an inch to an inch and a half long, resembling *M. calcarea*. The two species are probably identical. In these Arctic specimens the motion of the valves, though limited, and the branchial currents of the living animal may prevent full development, which progresses on the stone in the absence of any disturbing cause.

Delesseria sinuosa, Ag. Has been found in lat. 75° N.

Rhodophyllis veprecula, J. Ag. I possess specimens of this from Whale-Fish Islands.

Phyllophora interrupta, Grev. This remarkable and rare *Alga* was placed originally in the genus *Rhodymenia*. Fruiting specimens have been brought home by the late Swedish expedition to Spitzbergen, and Professor J. G. Agardh has thus been able to prove it to be a true *Phyllophora*, allied to *P. Brodiæi*, the fruit being disposed nearly as in that species.

Ceramium rubrum, Ag., var. δ, *virgatum*.

Ulva bullosa, L.

Ulva crispa, Lightf.

Porphyra vulgaris, Ag.
Specimens in my collection from the north extremity of Davis Straits are small, not exceeding two inches.

Cladophora rupestris, Kütz.

Chætomorpha Piquotiana, Mont.

Hormotrichum Carmichælii, Harv.

H. boreale, Harv.

H. Wormskioldii, Kütz.

Mougeotia (species doubtful).

Oscillatoria Corium, Ag.

Nostoc muscorum, Vaucher.

Nostoc microscopicum, Carm.

Nostoc verrucosum, Vaucher.

Scytonema myochrous, Ag.

Sorospora montana, Harv.

Hæmatococcus frustulosus, Harv.

Tyndaridea anomala, Harv.

SUMMARY.

Excluding *freshwater* species, of *marine* forms there have been found beyond 60° N. lat., along the shores of Davis Straits and Baffin's Bay and their branches, the following:—

	Species.
Melanospermeæ	25
Rhodospermeæ	22
Chlorospermeæ	16
	63

The Families represented are the following:—Fucaceæ, Sporochnaceæ, Laminariaceæ, Dictyotaceæ, Chordariaceæ, Ectocarpaceæ, Rhodomelaceæ, Corallinaceæ, Sphærococcoideæ, Rhodymeniaceæ, Cryptonemiaceæ, Ceramiaceæ, Ulvaceæ, Confervaceæ.

Collections in this department have been few; and as numerous localities remain to be explored, other species will doubtless be added.

Some of them occur in the greatest profusion; masses consisting chiefly of *Fucus vesiculosus, Desmarestia aculeata, Laminaria longicruris*, and *Alaria* are found floating in summer, set free doubtless by the action of icebergs. If to the higher forms we add the vast multitudes of marine *Diatomaceæ* which abound everywhere in the Arctic waters and upon ice-floes, it is obvious that even in very high latitudes there is abundance of material for the support of animal life*.

Not a few of the species occur also on the west coast of America, as shown by Professor Harvey's remarks on Dr. Lyall's collection in a recent volume of Linnean Proceedings. A comparison between the two marine floras as a whole is unnecessary, since Dr. Lyall's collections were made chiefly in much lower latitudes than the portion of the Atlantic to which the present communication refers.

* In the alimentary canal of various Mollusca brought home in spirits, I have invariably found abundance of Diatoms. And masses, which may be compared to "sodden biscuit," can be gathered from ice-floes, and on examination of such I find them to be pure *Diatomaceæ*.

Of the species enumerated here, the following are truly Arctic:—*Sphacelaria arctica*, *Kallymenia Pennyi*, *Halosaccion Dumontioides*, *Polysiphonia arctica*, and *Phyllophora interrupta**.

Our data are not sufficient to lead to any general conclusions as to species confined to the western side of the straits, or those peculiar to the east side; *Callithamnion Americanum* and *Kallymenia Pennyi*, however, are worthy of mention as hitherto known only on the west side.

Compared with the Antarctic sea, the Arctic is remarkably rich in species, if we are to judge from the *very few* recorded in the 'Flora Antartica' as found there.

In conclusion, three products usually plentiful in certain marine Algæ of low latitudes are also abundant in some of the Arctic species—viz. iodides, Mannite, and carbonate of lime. With respect to the latter, I need only allude to the presence of *Melobesia* and *Corallina officinalis*. *Laminaria saccharina*, as its name indicates, yields Mannite, which appears as a white efflorescence on the surface when the plant is roughly dried without being washed; but in this it is far exceeded by *Laminaria longicruris*, from which I have been able to procure the same product in plenty. The presence of iodides I have also tested on Arctic specimens with the following results, it being premised that a filtered and concentrated solution from a few grains of ash, with nitric acid and starch, is generally sufficient to give in a rough way proof of the amount of iodides, as indicated by tints varying from dark blue through purples to pale rose; and where iodides are in small proportion, the latter colour may not appear till after a few minutes:—

Fucus nodosus, pale purple;
F. vesiculosus, pale purple;
Dictyosiphon fœniculaceus, very dark blue;
Laminaria longicruris, pale rose;
Ptilota serrata, pale purple;
Ahnfeldtia plicata, pale rose;
Polysiphonia arctica, pale rose;
Ulva latifolia, pale rose, slowly;
Conferva Melagonium, pale purple.

* Among the numerous Phænogams of the Arctic regions, only one is, I believe, peculiar, viz. *Pleuropogon Sabini*.

Lichenes Novæ Zelandiæ, quos ibi legit anno 1861 Dr. Lauder Lindsay. By Wm. Nylander, M.D., Ph.D., late Professor of Botany in the University of Helsingfors, Russia. Communicated by Dr. Lindsay.

[Read November 2, 1865.]

Trib. I. Collemei.

Collema leucocarpum, *Tayl., Nyl. Nov. Granat.* p. 14; ed. 2, p. 2.
Ad cortices, Dunedin *.

Trib. II. Sphærophorei.

1. Sphærophoron tenerum, *Laur.*
Ad truncos emortuos, Dunedin.

2. Sphærophoron compressum, *Ach.*
Auckland (*Dr. Sinclair*).

Trib. III. Bæomycei.

Bæomyces fungoides, *Ach.*, thallo parum evoluto nonnihil recedens.
Supra terram, Tarndale, Nelson (*Dr. Sinclair*).

Trib. IV. Cladoniei.

1. Cladonia pyxidata (*L.*).
Supra terram, Dunedin.

2. Cladonia fimbriata, *Hffm.*
Ad truncos putrescentes inter muscos, Dunedin.

3. Cladonia degenerans, *Flk.*, formis *euphorea* (Ach.), *aplotea* (Ach.), et *lepidota* (Ach.). Cf. Nyl. Lich. Scandinav. p. 54.
Supra terram et truncos putridos, Dunedin.

4. Cladonia rangiferina, f. pumila, *Ach.*
Ad corticem truncorum putridorum, Dunedin.

5. Cladonia pycnoclada, *Pers.* (*Nyl. Syn.* p. 212). Differt a *Cl. rangiferina*, var. *sylvatica*, *Hffm.*, et a præcedente præsertim thallo opaco byssino-contexto (nec superficie cartilagineo-glabra); color jam flavicans, jam albicans.
Supra terram, Auckland (*Dr. Sinclair*), Dunedin.

6. Cladonia aggregata (*Sw.*), *Eschw.*
Frequens supra terram et truncos putridos, Dunedin †.

* Etiam Leptogiorum 2 vestigia in collectione aderant, sed statu haud bene determinabili.

† Est inter Lichenes exoticos vulgatissimus et cognitissimus. Singulari ignorantia dicit D. Koerber in *Reliquiis Hochstetterianis* (1862) de eadem *Cladonia*

7. CLADONIA RETIPORA, *Flk.*
Auckland (*Dr. Sinclair*).

Trib. V. STEREOCAULEI.

1. STEREOCAULON MACROCARPOIDES, *Nyl. Syn.* p. 238.
Auckland (*Dr. Sinclair*).

2. STEREOCAULON MIXTUM, *Nyl. ibid.*
Ad saxa ("trappean boulders"), Dunedin.

3. STEREOCAULON RAMULOSUM (*Ach. pr. p.*), *Nyl. Syn.* p. 235.
In rimis saxorum basalticorum, sterile, Dunedin.

4. STEREOCAULON CORTICATULUM, *Nyl. Syn.* p. 240.
Ad saxa micaceo-schistosa et quartzoso-conglomerata, Dunedin. Frequens.

Trib. VI. SIPHULEI.

THAMNOLIA VERMICULARIS, *Ach., Schær.*
Tarndale, Nelson (*Dr. Sinclair*).

Trib. VII. USNEEI.

1. USNEA BARBATA, f. FLORIDA (*L., Hffm.*).
Ad ramos arborum, Dunedin.

2. USNEA BARBATA, var. CERATINA (*Ach.*).
Ad arbores, Auckland (*Dr. Sinclair*), Dunedin.

3. USNEA BARBATA, var. ARTICULATA (*Ach.*).
Ad arbores, Dunedin.

4. NEUROPOGON MELAXANTHUS, var. CILIATUS, *Nyl.* Thallus pallido-flavescens, sursum virescenti-nigrescens, lævis vel sublævis, demum scrobiculose inæqualis, annulatim ruptus (rimis sæpius nigricantibus); apothecia nigra (latit. 3–7 millim.), receptaculo (vel margine) ciliis nonnullis munito; sporæ incolores breviter ellipsoideæ vel globoso-ellipsoideæ (longit. 0·009–0·011 millim., crassit. 0·007–0·009 millim.). Spermatia (dimidia parte infera fusiformi-incrassatula) longit. 0·009–0·010 millim. Forte species distincta a *melaxantho*.
Tarndale, Nelson (*Dr. Sinclair*).

Trib. VIII. RAMALINEI.

1. RAMALINA CALICARIS (*Ach.*), *Nyl., Syn.* p. 293.
Ad corticem arborum, Dunedin.

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aggregata, p. 30: "memorabilis—antea nonnisi in Brasilia lecta," confusionem sane miram faciens cum *Cl. gorgonea*, Eschw., longissime dissimili, sicut perspicere facile erat (e mea *Syn.* p. 213), atque ut fide speciminum Hochstetteri affirmavit in litteris D. von Krempelhuber.

Trib. IX. Peltigerei.

1. Peltigera rufescens, *Hffm.* Apothecia variantia albo-cæsio suffusa.

Ad truncos putridos, Dunedin.

2. Nephroma antarcticum, var. tenue, *Nyl. Syn.* p. 317.
Ad truncos arborum emortuos, Dunedin.

Trib. X. Parmeliei.

1. Stictina fragillima (*Bab.*), f. lutescens, *Kphb. in litt.*, thallo flavescente pro maxima parte lacinias sistens medio longitudinaliter canaliculato-impressas et subtus costam habentes distinctam subexcurrentem (nec nisi in apicibus deplanatis evanescentem). Sterilis *.

Tarndale, Nelson (*Dr. Sinclair*).

2. Stictina dissimilis (*Nyl. Syn.* p. 336). Thallus luridus, vel lurido-pallescens (facie supra sæpe fere ut in *Stictina quercizante* Americana). Sterilis.

Supra truncos arborum vetustos, Dunedin.

3. Stictina crocata (*L.*), *Nyl. Syn.* p. 338.

Ad saxa micaceo-schistosa, Dunedin.

4. Stictina fuliginosa (*Dicks.*), *Nyl. Syn.* p. 347.

Tarndale, Nelson (*Dr. Sinclair*).

5. Sticta latifrons, *Rich. Astrol.* p. 27, t. 8. f. 2; *Bab. New Zeal.*, p. 13. Thallus flavescens rigescens, lævis vel sublævis, magnus (latit. 4–7 pollicum et amplius), stipitatus, lobato-incisus, lobis infra versus basin costato-nervosis, margine sinuato-crenato, subtus ochraceo-lutescens (basi obscuriore); cyphellæ fundo lutescente plano, sat latæ, thelotremoideæ; apothecia rufa vel fusco-rufa vel fusca, mediocria, margine crenulato; sporæ 8næ, incolores, fusiformes, 1-septatæ (rarius 3-septatæ), longit. 0·025–0·035 millim., crassit. 0·008–0·010 millim. Gonidia eximia, globulosa (diam. 0·009–0·023 millim.), pariete crasso.

Ad truncos arborum frequenter, Dunedin †.

6. Sticta filix (*Hffm. Pl. Lich.* t. lv.), *Bab. New Zeal.* p. 12 (*Ach. pr. p.*). Thallus pallidus, pallido-luridus vel pallido-glaucescens, sat tenuis, mediocris, subopacus, stipitatus (stipite firmo), lobato-incisus,

* In typica *Stictina fragillima* e Nova Zelandia sporas vidi dilute fuscescentes, longit. 0·025–0·033 millim., crassit. 0·008–0·010 millim. Variat ei thallus lurido-glaucescens.

† Etiam in Nova Zelandia occurrit *Sticta Menziesii*, Hook., quæ vix est nisi varietas *latifrontis*, sicut vult cel. Babington (New Zeal. p. 13 et t. 122). Thallus ei pallidus vel lurido-pallescens vel lurido-fuscescens, subtus tomento rhizineo fusco, cyphellis albidis (fundo subpulvereo); sporæ longit. 0·027–0·037, crassit. 0·009–0·011 millim., 1–3-septatæ.

lobis infra costatis, margine varie sinuato-crenato vel crenato-dissecto, subtus pallido-ochraceus vel ochraceo-rufescens versus basin ibi fuscescens (nudus vel subnudus), tomento rhizineo tenui obsoleto vel nullo; cyphellæ pallidæ; apothecia rufo-pallescentia vel fusco-rufa, sat parva (latit. 1–2 millim.), margine thallino integro parum prominulo (vel demum subexcluso); sporæ 8næ, incolores, fusiformes, 1–3-septatæ, longit. 0·030–0·038 millim., crassit. 0·009–0·011 millim. Gonidia diam. 0·006–0·011 millim.

Ad truncos arborum, Dunedin *.

Var. PARVULA, *Nyl.*, minor, thallo dissecto tenui, subtus cephalodiis frequentibus; sporæ 1-septatæ, longit. 0·033–0·043, crassit. 0·008–0·010 millim. Tarndale, Nelson (*Dr. Sinclair*).

7. STICTA DAMÆCORNIS, var. SUBCAPERATA, *Nyl.* Similis fere *caperatæ*, Bor., sed thallo tenuiore coloris sicut in *damæcorni* typica pallido-luridi; sporæ longit. 0·026–0·046 millim., crassit. 0·009–0·011 millim. Accedit ad *Stictam variabilem*.

Ad truncos, Dunedin.

8. STICTA SUBCORIACEA, *Nyl.* Thallus pallido-luridus vel pallide lurido-flavescens (ambitu sæpe fuscescens), late expansus (5-pollicaris usque pedalis latitudinis), rigens, superficie tenuiter coriaceo-rugulosus, sublævis, laciniato-divisus, laciniis pinnatifidis, apice retusis et ambitu albo-pilosulis, subtus ochraceo-pallescens tomentoso-rhizinosus; cyphellæ albæ, mediocres (fundo subfarinoso); apothecia fusco-rubricosa vel nigricantia, mediocria, marginalia, receptaculo rugoso (in junioribus albo-pilosulo); sporæ 8næ, fuscæ, oblongo-fusiformes, 1-septatæ, longit. 0·023–0·033 millim., crassit. 0·009–0·013 millim. Gonidia diam. 0·004–0·008 millim.†

Ad truncos arborum, Dunedin.

9. STICTA URVILLEI, *Del.*, *Nyl.*, *Syn.* p. 360, atque varr. FLAVICANS (*Hook.*), et (COLENSOI *Bab.*).

Ad truncos arborum, Dunedin.

10. STICTA ORYGMÆA, *Ach.*, *Nyl. l. c.*

Ad truncos arborum, Dunedin.

11. STICTA RUBELLA, *Hook. et Tayl.*, *Nyl. Syn.* p. 361.

Ad truncos arborum emortuarum, Dunedin. Sterilis.

12. STICTA GRANULATA, *Bab.* (*Nyl. Syn.* p. 340). Apothecia nigricantia, marginalia, mediocria, margine integro; sporæ fuscæ, physci-

* Variat in Nova Zelandia thallo margine minus diviso, apotheciis extus in statu juvenili glabris (in typica vulgo ruguloso), sporis 1-septatis (longit. 0·034–0·048, crassit. 0·009–0·010 millim.), gonidiis diam. 0·005–0·008 millim.

† *Sticta subcoriacea* facie est *Stictæ damæcornis* majoris firmioris, sed thallo superficie subcoriaceo-ruguloso et ambitu albo-pilosulo accedit ad *Ricasoliam coriaceam*, habet autem thallum magis divisum, receptacula nudiora, cyphellas alias, etc.

oideæ (biloculares, tubulo loculos inter se jungente), longit. 0·027–0·030 millim. crassit. 0·009–0·012 millim. Accedere facie externa videtur *Stictinæ carpolomæ*, differt autem thallo sæpius firmiore cinerascenti-albido, gonidiis, &c. Pseudocyphellæ sæpe dealbatæ. Gonidia diam. 0·010–0·018 millim.

Ad cortices arborum, Auckland (*Dr. Sinclair*), Dunedin.

13. STICTA DISSIMULATA var. MULTIFIDA (*Laur.*), *Nyl. Syn.* p. 363. Thallus subtus cephalodiifer et pseudocyphellis sæpe rarescentibus (interdum vix ullis visibilibus); sporæ 1–3-septatæ, longit. 0·025–0·042 millim., crassit. 0·008–0·011 millim. Gonidia diam. 0·004–0·008 millim.

Ad truncos arborum, Dunedin.

14. STICTA FOSSULATA, *Duf.*, *Nyl. Syn.* p. 363, et var. RICHARDII (*Mnt.*).

Ad truncos arborum, Dunedin.

15. STICTA PHYSCIOSPORA, *Nyl. Syn.* p. 364.

Ibidem ad cortices.

16. STICTA FREYCINETII, *Del.*, *Nyl. Syn.* p. 365.

Ad truncos et ad saxa basaltica.

17. STICTA EPISTICTA, *Nyl.* Thallus albido-pallescens vel pallido-glaucescens, mediocris, vix rigescens, lævis, laciniato-divisus, laciniis varie margine crenatis vel dissectis, punctis albis pseudocyphelloideis minutis conspersus, subtus pallidus, tomentoso-rhizinosus (cyphellis nullis vel vix ullis visis, cephalodiis parcis); apothecia non visa *.

Ad truncos arborum, Dunedin.

18. RICASOLIA CORIACEA (*Hook. et Tayl., Bab. New Zeal.* p. 19, t. 125 A), *Nyl. Syn.* p. 366.

Ad truncos arborum, Auckland (*Dr. Sinclair*), Dunedin.

19. RICASOLIA HERBACEA, var. ADSCRIPTA, *Nyl.* Differt a typica thallo adpresso nonnihil tenuiore et infra passim fere subnudo, cephalodiis haud raris. Sporæ dilute fuscescentes, longit. 0·034–0·052 millim., crassit. 0·009–0·012 millim.

Ad cortices, Tarndale, Nelson (*Dr. Sinclair*), Dunedin.

20. RICASOLIA MONTAGNEI (*Bab. New Zeal.* p. 20). Apothecia spadiceo-rufescentia vel fusca, mediocria vel majuscula, margine receptaculari ruguloso vel subruguloso (interdum lobulis coronato); sporæ 3-septatæ; longit. 0·032–0·042 millim., crassit. 0·007–0·009 millim.

Ad cortices arborum, Dunedin.

* Laciniæ thalli subcanaliculatæ vel latiores subplanæ. Accedere videtur ad *Stictam Freycinetii*, sed color alius, cyphellæ nullæ, puncta pseudocyphelloidea paginæ superæ thalli, etc., distinctionem jubent. Gonidia diam. 0·007–0·011 millim. Laciniæ pagina infera convexæ conspiciuntur. Variat color thalli fuscescens in saxicola, nam etiam ad saxa occurrit *Sticta episticta*.

21. Parmelia perforata, *Ach.*, *Nyl. Syn.* p. 377.
Ad cortices arborum et ad saxa frequens, Dunedin.

22. Parmelia physodes, var. enteromorpha, *Ach.*, *Tuck.*, *Bab. New Zeal.* p. 22; *Nyl. Syn.* p. 401.
Ad cortices, Auckland (*Dr. Sinclair*), Dunedin.

23. Parmelia pertusa (*Schrank*), *Schær.*, *Nyl. Syn.* p. 410; Parmelia diatrypa, *Ach.*, *Bab. New Zeal.* p. 22.
Ad truncos, Dunedin.

24. Parmelia lævigata, var. revoluta (*Flk.*), *Nyl. Syn.* p. 385. Subsimilis *tiliaceæ*; sporæ longit. 0·010–0·012 millim., crassit. 0·007–0·009 millim.
Ad corticem, Auckland (*Dr. Sinclair*).

25. Parmelia conspersa, *Ach.*, *Nyl. Syn.* p. 399.
Ad saxa frequentissime, Dunedin.

26. Parmelia Mougeotii, *Schær.*, *Nyl. Syn.* p. 400.
Ad saxa frequentissime, Dunedin.

27. Physcia chrysophthalma (*L.*), *DC.*, *Nyl. Syn.* p. 410.
Ad corticem arborum vel ramulos, Auckland (*Dr. Sinclair*), Dunedin.

28. Physcia parietina (*L.*) *DC.*, *Nyl. Syn.* p. 410. Non differt ullo modo *Ph. ligulata*, Krb. Reliq. Hochstett, p. 30 (vid. Nyl. in 'Flora,' 1864, p. 266).
Ad cortices et saxa, Dunedin.

29. Physcia stellaris, f. radiata (*Ach.*), *Nyl. Lich. Scand.* p. 111.
Ad cortices, Dunedin. Etiam saxicola sterilis congesto-laciniata, ibidem.

30. Physcia plinthiza, *Nyl.* Similis fere *Physciæ obscuræ* mediocri, sed thallo tenuiore, sporis valde diversis 6–8-locularibus (longit. 0·030–0·044 millim., crassit. 0·011–0·014 millim.). Apothecia fusco-nigricantia, mediocria (latit. 1·2–1·5 millim.); sporæ fuscæ, oblongæ, 6–8-loculares, loculis vulgo sat parvis et mediis 2 sæpe didymis (ita medio series 2 adsunt transversæ biloculares), quod in memoriam revocat sporas *Lecanoræ diplinthiæ*, Nyl., Novo-Granatensis. Spermogonia ut in *Physcia adglutinata* (ad cujus stirpem pertinet *Physcia plinthiza*, vel stirpem analogam format in genere *Physcia*); spermatia gracillima, recta, longit. 0·016–0·018 millim., crassit. 0·0005 millim.
Ad truncos arborum, Dunedin.

Trib. XI. Lecanorei.

1. Pannaria immixta, *Nyl.* Thallus cinereus, squamulosus, squamulis tenuibus crenatis vel crenato-lobatulis subimbricatis, hypothallo nigricante sat tenui superstratus; apothecia testaceo-rufa, fere mediocria (latit. 0·9–1·2 millim.), plana, margine thallino crenulato cincta; sporæ ellipsoideæ, longit. 0·012–0·016 millim., crassit. 0·007–0·008.

Gelatina hymenæa iodo (saltem dilute) cærulescens. Facie fere *Pannariæ triptophyllæ*, apotheciis vero lecanorinis, etc., mox distinguitur. *P. pholidota* (Mont.) differt squamulis thalli firmioribus aliter coloratis, sporis majoribus, etc. Forte ad *immixtam* pertineat *pholidota* Bab. *New Zeal.* p. 26, t. 128 A.

Ad corticem arborum, Dunedin.

2. PANNARIA LEUCOSTICTA, *Tuck. in Darl. Fl. Cestr.* ed. 3, p. 441. Forma thallo sordide pallido-cinereo crenato-squamuloso, squamulis adscendentibus crassiusculis crenatis; apothecia rufa determinate lecanorina, margine crenato; sporæ ellipsoideæ, simplices, longit. 0·016–0·020 millim., crassit. 0·009–0·013 millim. Gelatina hymenæa iodo vinose rubens (præcedente cærulescente).

Supra terram in rimis saxorum micaceo-schistosorum, Dunedin.

3. PANNARIA GYMNOCHEILA, *Nyl.* Thallus pallens vel pallido-flavidus, ambitu stellato-radians, laciniis irregularibus, centro (vel pro magna parte) granulose cæsio-leprosus; sporæ ellipsoideæ, simplices (longit. 0·016–0·018 millim., crassit. 0·009–0·011 millim.). Gelatina hymenæa iodo cærulescens (thecæ apice intensius tinctæ).

Ad cortices arborum prope Dunedin (socia *Collematis leucocarpi*).

4. PANNARIA NIGRA (*Huds.*), *Nyl. Lich. Scandin.* p. 126. Omnino similis europææ. Sporæ ellipsoideæ 1-septatæ, longit. 0·013–0·014 millim., crassit. 0·005 millim.

Ad saxa ("Shell-Limestone"), Dunedin.

5. LECANORA (PSOROMA) SPHINCTRINA (*Mnt. Voy. Pôle Sud*, p. 180, t. 15. f. 3). Variabilis.

Ad truncos arborum, Dunedin.

Var. PHOLIDOTOIDES, *Nyl.* Thallus pallido-cervinus, squamulosus, squamulis parvis adpressis firmulis sublobatis, hypothallo nigro; apothecia (squamulis vulgo majora) fusconigra, plana, mediocria (latit. 1 millim.), margine thallino crenato cincta; sporæ longit. 0·013–0·018 millim., crassit. 0·007–0·010 millim. Gelatina hymenæa iodo cærulescens. Facie fere *Pannariæ pholidotæ* (Mnt.), sed gonidiis, etc. mox distincta. Confluit cum var. *discreta*.

Ad truncos ibidem.

6. LECANORA (PLACOPSIS) GELIDA (*L.*), *Ach.*; SQUAMARIA GELIDA, *Hook.*, *Nyl. Lich. Scandin.* p. 134.

Ad saxa basaltica, Dunedin.

7. LECANORA (PLACOPSIS) PERRUGOSA, *Nyl.* Thallus cinereo-fuscescens vel sordide cinereo-rufescens vel pallido-cervinus, totus verrucoso-rugosus rimoso-diffractus, rimis versus ambitum radiantibus et radios lineares (plus minus distinctos) formantibus, ipso ambitu pterygioideo-expansis et sæpe ibi deplanatis; cephalodia sordide pallida vel ochraceo-pallida, convexula, placodioidea (demum rhagodiose fissa); apothecia rufescenti-fusca vel rufo-badia, fere mediocria (latit. circiter 1 millim.), plana, marginem thallinum æquantia (interdum etiam

marginem tenuem proprium offerentia); sporæ ellipsoideæ, longit. 0·014–0.015 millim., crassit. 0·007–0.009 millim. Gelatina hymenæa iodo cærulescens *.

Ad saxa basaltica (socia *Placopseos gelidæ*), Dunedin.

8. LECANORA (SQUAMARIA) GALACTINA, var. DISPERSA (*Pers.*), *Nyl. Lich. Scandin.* p. 162. Sporæ longit. 0·012–0·014 millim., crassit. 0·006–0·007 millim.

Ad basaltum porphyreum, Dunedin.

9. LECANORA VITELLINA, *Ach., Nyl. Lich. Scandin.* p. 141.

Ad saxa varia frequenter inter alios lichenes crustaceos sparsa, Dunedin.

10. LECANORA AURANTIACA, var. ERYTHRELLA (*Ach.*), *Nyl. Lich. Scandin.* p. 142. Sporæ longit. 0·012–0·021 millim., crassit. 0·007–8 millim.

Ad saxa, Dunedin.

11. LECANORA PYRACEA (*Ach.*), *Nyl. Lich. Scandin.* p. 145. Sporæ (formæ ut in *L. cerina*, Ach.) longit. 0·011–0·014 millim., crassit. 0·005–0·007 millim.

Ad saxa basaltica, Dunedin.

12. LECANORA HOMOLOGA, *Nyl.* Thallus, albidus, rugulosus; apothecia fusca, mediocria (latit. 1 millim.), margine thallino integro cincta; sporæ 8næ, incolores, ellipsoideæ, transversim 3-loculosæ (loculis his 3 inter se tubulis 2 jungentibus tenuibus connexis), longit. 0·022–0·025 millim., crassit. 0·011–0·012 millim.,; paraphyses articulatæ, mediocres (apice sensim incrassato dilute fuscescente). Species insignis apotheciis fuscis et sporis fere sicut in *Lecanora Brebissonii* (Fée), cum qua in serie generis est analoga. Gelatina hymenæa iodo intense cærulescens.

Ad corticem arborum, socia *Physciæ plinthizæ*.

13. LECANORA PELOLEUCA, *Nyl.* Thallus albidus, sat tenuis, areolato-rimosus, subindeterminatus vel fere determinatus; apothecia fusco-nigra vel nigra, sat parva (latit. 0·4–0·5 millim.) margine thallino integro cincta, intus pallida; sporæ 8næ, fuscæ, ellipsoideæ, 1-septatæ, longit. 0·020–0.027 millim., crassit. 0·009–0·011 millim.; paraphyses tenues, molles (inde non semper bene distinctæ). Gelatina hymenæa iodo cærulescens. Species est stirpis *Lecanoræ sophodis,* facie extus fere *Lecanoræ cinereæ*.

Ad basaltum, Dunedin.

* Notis datis a *Placopsi gelida* differt, et præsertim thallo crebre rugifero et obscuriore (colore fere ut in *Physcia aquila* pallidiore). Thallus sæpe late expansus; in vetusto simul verrucæ rugosæ majores conspiciuntur; centrum potius cinerascens et irregulariter areolato-diffractum; crassities usque 1 millmetrum adtingit, sed vulgo dimidia parte est tenuior. Apothecia conferta. Spermatia gracilia, leviter arcuata vel subrecta; longit. 0·018–0·023 millim., crassitie haud 0·001 millim. adtingente. Quoad characteres subgeneris *Placopseos*, cf. *Nyl. Lich. And. Boliv.* p. 376; pertinent huc (1) *Pl. gelida*, (2) *Pl. hiulca* (Nyl. Chil. p. 153), (3) *Pl. rhodocarpa*, Nyl. (in Ann. Sc. Natur. 4. xv. p. 376), (4) *Pl. perrugosa*, Nyl., et (5), *Pl. albida*, Nyl. Nov Granat. ii. p. 146 (e Java).

14. Lecanora thiomela, *Nyl.* Thallus sulphureo-flavus, tenuis, granulatus vel subgranulato-inæqualis; apothecia nigra vel nigricantia, fere mediocria vel parva, margine thallino subintegro (vel leviterc renulato) cincta; sporæ 8næ, fuscæ, 1-septatæ, longit. 0·023–0·030 millim., crassit. 0·014–·0·015 millim.; paraphyses fere mediocres; epithecium (lamina tenui visum) sordide lutescens; hypothecium incolor. Gelatina hymenæa iodo cærulescens. Affinis est *Lecideæ lepidæ*, Nyl., Brasiliensi, at differens variis notis, thallo granulato, paraphysibus distinctioribus, etc.
Ad porphyrum basalticum, Dunedin.

15. Lecanora umbrina (*Ehrh.*), *Nyl. Lich. Scandin.* p. 162. Sporæ longit. 0·007–0·010 millim., crassit. 0·0045 millim.
Ad ligna vetusta ("on stockyard palings of *Goai* timber"), Dunedin.

16. Lecanora atra, *Ach.*, *Nyl. Lich. Scandin.* p. 170.
Ad cortices arborum et saxa, Dunedin.

17. Lecanora punicea, *Ach.*, *Nyl. Nov. Granat.* p. 32, t. 1. fig. 5 (sporæ). Sporæ fusiformes, 5–7-septatæ, longit. 0·034–0·052 millim., crassit. 0·0045 0·0055 millim.
Ad cortices arborum, Dunedin.

18. Lecanora chrysosticta, *Tayl.*; Heterothecium Berteroanum, *Mnt. Chil.* p. 176, t. 12. f. 5. Thallus albidus, sat tenuis, rugulosus. rimosus, determinatus; apothecia fulvo-aurantiaca, opaca, mediocria, margine thallino integro (vel obsolete crenato) cincta, intus incoloria; thecæ monosporæ; sporæ incolores, ellipsoideæ, murali-divisæ, longit. 0·07–0·13 millim., crassit. 0·036–0·050 millim.; paraphyses graciles. Gelatina hymenæa iodo cærulescens.
Ad cortices arborum, Dunedin.

19. Lecanora simplex (*Dav.*), *Nyl. Prodr. Gall. Alger.* p. 146; *Lich. Scandin.* p. 176. Vix ullo modo differens ab europæa.
Ad rupes ("on Trap tuffe"), socia *Lecanoræ vitellinæ*, Dunedin.

20. Urceolaria scruposa, *Ach.*, *Nyl. Lich. Scandin.* p. 176. Sporæ fuscæ, oblongæ, submurali-divisæ, longit. 0·018–0·027 millim., crassit. 0·009–0·011 millim.
Supra terram, Dunedin.

21. Urceolaria stictica, *Krb. Reliq. Hochstett.* p. 32; *Nyl. in Flora*, 1864, p. 267. Thallus cinereus vel obscure cinereus, opacus, depressus, areolato-diffractus; apothecia nigra, innata (1 vel plura in quavis areola thalli); sporæ fusco-nigrescentes, ellipsoideæ, murali-divisæ, longit. 0·023–0·028 millim., crassit. 0·016–0·018 millim., iodo cærulescentes.
Ad saxa conglomerato-quartzosa, Green-Island, Peninsula, Dunedin.

22. Pertusaria communis, *DC.*, *Nyl. Lich. Scandin.* p. 178. Etiam

sporis endosporio in iisdem apotheciis jam lævi jam transversim plicatulo.

Ad corticem truncorum arborum, Dunedin.

23. Pertusaria velata (*Turn. in Trans. Linn. Soc.* ix. 1808, t. 12. f. 1; *E. Bot.* t. 2062), *Nyl. Lich. Scandin.* p. 179. Thecæ monosporæ; sporæ maximæ (longit. circiter 0·240 millim., crassit. 0·105 millim.), pariete crasso crebre transversim tenuiter strigatulo (quod etiam in europæa obsolete conspicitur et quod non confundatur cum endosporio transversim plicatulo, plicis fere totam sporam transverse percurrentibus), pariete earum inde strigulis quasi radioso. Obiter visa sæpe faciem habet *Lecanoræ glaucomæ*. Saxicola.

Ad saxa basaltica, Dunedin.

24. Pertusaria perrimosa, *Nyl.* Thallus albido-cinerascens, sat tenuis, rimoso-diffractus vel rimoso-areolatus, determinatus; apothecia in verrucis thalli convexis (supra thalli planitiem prominulis, rarius depressis) difformibus rimoso-fissis innata, plura in quavis verruca, ostiolis nigricantibus punctiformibus; sporæ 8næ, incolores, ellipsoideæ, longit. 0·085–0·172 millim., crassit. 0·060–0·082 millim. Gelatina hymenæa iodo cærulescens*.

25. Pertusaria perfida, *Nyl.* Thallus albido-cinereus vel cinereus, areolato-diffractus (crassit. circiter 0·4 millim. vel tenuior); apothecia nigricantia, lecanorina, parva, margine thallino vix prominulo; sporæ 6–8næ, incolores, ellipsoideæ, longit. 0·030–0·040 millim., crassit. 0·018–0·023 millim.; paraphyses gracilescentes. Gelatina hymenæa et thecæ iodo cærulee tinctæ†.

Ad saxa basaltica et conglomerata, Dunedin.

26. Thelotrema lepadinum, *Ach., Nyl. Lich. Scandin.* p. 185. Sporæ longit. 0·075–0·080 millim., crassit. circiter 0·016 millim.

Ad cortices arborum frequens, Dunedin.

* Fortasse sub varietatibus *Pertusariæ leioplacæ* subsumi possit, sed typo thalli subareolato-diffisso et facie peculiari distare videtur. Variat ceteroquin thallus pallide rufescens.

† Interdum faciem habet fere *Lecanoræ cinereæ* (*gibbosæ*), sed sporæ pariete crassiore. Apothecia sæpe demum discreta et margine thallino albicante (irregulari vel interdum subcrenulato) cincta. *Pertusaria nolens*, Nyl. in 'Flora,' 1864, p. 489 (in Hibernia detecta a cl. Jones), mox differt thallo lævigato et apotheciis omnino innatis atque sporis. *Pertusaria erubescens* (Tayl.) differt colore thalli rimoso-diffracti, apotheciis minus discretis et sporis majoribus. Memoretur etiam hic *Pertusaria subverrucosa*, Nyl. (coll. Colenso, no. 4694), in Nova Zelandia occurrens verisimiliter saxicola (sporis binis in quavis theca), est *Parmelia verrucosa* Bab. 'New Zeal.' p. 29. In collectione Doctoris Lauder Lindsay e Nova Hollandia, Sydney, Botany Bay, ad ligna sicca *Pertusaria pustulata* (Ach.) et *Pertusaria leioplaca* (Ach.) simul cum *Physcia picta* (Sw.), *Lecanora parella* Ach., *Lecanora varia*, var. *conizæa* (Ach.), *Lecidea disciformi* (Fr.), &c.

27. THELOTREMA MONOSPORUM, *Nyl. Lich. Nov. Caled*, p. 46. Facie *Thelotrematis cavati* minoris, sed thecis monosporis, sporis fusco-nigrescentibus fusiformi-oblongis murali-divisis (longit. 0·088–0·115 millim., crassit. 0·018–0·025 millim., iodo non tinctis).
Ad corticem arborum, Dunedin.

Trib. XII. LECIDEEI.

1. CŒNOGONIUM IMPLEXUM, *Nyl. in Ann. Sc. Natur.* 4. xvi. p. 92.
Ad truncos arborum, Dunedin.

2. LECIDEA FURFURACEA, *Pers. in Gaudich. Uran.* p. 192; *Nyl. Novo-Gran.* ii. p. 56. Sporæ oblongæ, simplices, longit. 0·009–0·011 millim., crassit. 0·003–0·004 millim.

Ad truncos arborum, Dunedin.

3. LECIDEA SUBSIMILIS, *Nyl. Novo-Granat.* ii. p. 62. Extus subsimilis *Lecideæ furfuraceæ*, sed apotheciis intus totis pallidis et sporis (oblongis vel bacillari-oblongis) longit. 0·009–0·012 millim., crassit. 0·002–0·003 millim., paraphyses non discretæ. Gelatina hymenæa iodo cærulescens (thecæ intensius tinctæ), deinde lutescens.
Ad corticem arborum (socia *Opegraphæ agelæoidis*, Nyl.), Dunedin.

4. LECIDEA SABULETORUM, *Flk. in Berl. Magaz.* 1808, p. 309 (excl. varr.); *Nyl. Lich. Scandin.* p. 204. Varians hypothecio superne fuscescente vel subfusco.
Supra terram rupium, Dunedin.

5. LECIDEA TRACHONA, var. MARGINATULA, *Nyl.* Thallus cinerascens vel cinereo-flavescens, tenuis, areolato-rimosus vel obscurior indeterminatus; apothecia parva (latit. 0·3–0·5 millim.), plana, marginatula (margine sæpius persistente), intus concoloria; sporæ incolores, oblongo-fusiformes, 3-septatæ, longit. 0·014–0·017 millim., crassit. 0·0045 millim., sæpius curvulæ vel nonnihil flexæ; paraphyses fere mediocres (vel non semper bene discretæ); epithecium subincolor; hypothecium nigricans vel nigrum. Gelatina hymenæa iodo cærulee tincta.
Ad saxa basaltica, Dunedin.

6. LECIDEA ALLOTROPA, *Nyl.* Thallus vix ullus visibilis; apothecia nigra, planiuscula, immarginata, parvula (latit. circiter 0·4 millim.), intus albida; sporæ 8næ, incolores, oblongæ, 3-septatæ, longit. 0·011–0·013 millim., crassit. 0·0045 millim.; paraphyses non discretæ; epithecium cæruleo-nigrescens; hypothecium incolor. Gelatina hymenea iodo intense cærulescens*.
Ad saxa micaceo-schistosa, Dunedin.

7. LECIDEA COARCTATA (*Ach.*), var. EXPOSITA, *Nyl.*—Thallus albido-cinereus, tenuis, opacus, areolatus, depressus; apothecia nigrofusca vel

* Forte prope *Lecideam trachonam* sit disponenda, licet apothecia sunt nigra (sin nonnihil fuscescentia).

nigra, convexa (latit. circiter 0·5 millim.); sporæ incolores, ellipsoideæ, simplices.

Ad saxa quartzoso-conglomerata, Dunedin.

8. LECIDEA MELANOTROPA, *Nyl.* Thallus albidus, tenuis, subdeterminatus, rimosus, subrugulosus; apothecia pallido-nigricantia (sæpe juniora pro parte corneo-glaucescentia), demum nigra, plana vel planiuscula (latit. 0·5–0·6 millim.), margine obtuso vel explanato, intus albida; sporæ 8næ, incolores, ellipsoideæ, 1-septatæ, longit. 0·015–0·016 millim., crassit. 0·007 millim.; paraphyses gracilescentes (apice parte incrassatula nigricante); hypothecium incolor. Gelatina hymenæa iodo vinose rubens (vel fulvescens). Accedat potius ad *Lecideam endochromam*, Fée, quam ad *intermixtam*. Variant apothecia subcæsio-pruinosa.

Ad lignum, Dunedin. Etiam corticola (socia *Collematis leucocarpi*).

9. LECIDEA MARGINIFLEXA, *Tayl., Bab. New Zeal.* p. 35, t. 129 B.

Ad cortices frequens, Dunedin.

10. LECIDEA MILLEGRANA (*Tayl. in Hook. Journ. Bot.* 1847, p. 159, *sub* Lecanora), *Nyl. Novo-Granat.* p. 64. Sporæ aciculares, 9–13-septatæ, longit. 0·046–0·070 millim., crassit. 0·0045 millim. Subsimilis *Lecideæ luteolæ* (*rubellæ*) (Ach.).

Ad cortices (mixta cum *Lecidea melanotropa*), Dunedin.

11. LECIDEA PULVEREA, *Borr.*, f. LAUROCERASI, *Del., Dub.*; L. ENDOLEUCA, *Nyl.*; L. ATROGRISEA (*Del. pr. p.*), *Stitz. Lecid.* p. 62*. Sporæ 7–15-septatæ, longit. 0·060–0·100 millim., crassit. 0·0040–0·0045 millim.; epithecium fuscescens. Gelatina hymenæa iodo cærulescens.

Ad cortices arborum, Dunedin.

12. LECIDEA LEUCOTHALAMIA, *Nyl.* Thallus albidus, tenuis vel tenuissimus, indeterminatus; apothecia albida, opaca, plana, margine (excipulo) cinereo-fusco, fere mediocria (latit. 0·6–0·9 millim.); sporæ 8næ, incolores, aciculares (3–7-septatæ aut septis indistinctis), longit. 0·034–0·052 millim., crassit. 0·0035–0·0040 millim.; paraphyses (gracilescentes) non bene discretæ; epithecium leviter lutescens; hypothecium (excipulum) fuscum. Gelatina hymenæa iodo cærulescens†.

13. LECIDEA OTAGENSIS, *Nyl.* Thallus albidus, rugulosus, determinatus vel obscure limitatus; apothecia nigra, mediocria (latit. 1 millim. vel minora), planiuscula, obtuse marginata (margine obtuso vel subexcluso), intus medio pallescentia; sporæ 8næ, incolores, fusiformi-aciculares (infra aciculari-attenuatæ), vulgo 5-septatæ, longit. 0·040–0·050 millim., crassit. 0·005 millim.; paraphyses mediocres (apice in-

* In herbario Deliseano hæc sub variis nominibus occurrit.

† Apothecia ocelliformia facile speciem hanc distinguunt; ea interdum sunt latitudinis 1 millim., et variant obscuriora. In statu humido apothecia glauco-hyalina. Occurrit etiam varietas *melachroa* apotheciis supra totis nigricantibus.

crassato nigrescente); hypothecium leviter (vel levissime in lamina tenui) fuscescens; excipulum lateribus (æque ac epithecium) nigricans. Gelatina hymenæa iodo cærulescens (thecæ apice intensius tinctæ)*.
Ad cortices arborum, Dunedin.

14. LECIDEA ARCEUTINA, *Ach.* (primitus sic dicta). Thallus albus, tenuis, indeterminatus; apothecia nigricantia, mediocria, primo marginata, dein convexa, intus incoloria; sporæ incolores, aciculares (septis tenuibus sæpe visibilibus 5–9), longit. 0·046–0·066 millim., crassit. circiter 0·002 millim.; paraphyses gracilescentes. Gelatina hymenæa iodo cærulescens (dein lutescens). Variat apotheciis excipulo rufescente et sporis longitudine usque 0·075 millim., crassit. usque 0·0025 millim.
Ad corticem arborum, Dunedin.

15. LECIDEA AMPHITROPA, *Nyl.* Thallus sordide albidus, ex areolis firmis graniformibus vel difformibus constans; apothecia nigra, planiuscula, obtuse marginata vel immarginata, intus concoloria, fere mediocria; sporæ 8næ, fusiformes, incolores (simplices vel 1–3-septatæ), longit. 0·016–0·025 millim., crassit. 0·0040–0·0045 millim.; paraphyses gracilescentes, apice nigro-clavatæ; hypothecium fuscum; excipulum laterale (perithecium) nigrum. Gelatina hymenæa iodo cærulescens, dein vinose violacea †.
Supra terram rupium, Dunedin.

16. LECIDEA PARASEMA (*Ach.*), *Nyl. Lich. Scandin.* p. 210, atque varr. LATYPEA (*Ach.*) et ENTEROLEUCA (*Ach.*)
Ad saxa varia frequens, Dunedin.

17. LECIDEA CONTIGUA, var. MEIOSPORA, *Nyl. Lich. Scandin.* p. 225. Sporæ longit. 0·014 millim., crassit. 0·007–0·008 millim.
Supra terram argillaceam, Auckland.
Var. CRUSTULATA, *Ach. Nyl. l. c.* Sporæ longit. 0·010–0·011 millim., crassit. 0·006 millim.
Ad saxa arenaria, Dunedin.

18. LECIDEA LAPICIDA, var. DECLINANS, *Nyl. Lich. Scandin.* p. 226. Sporæ longit. 0·011–0·014 millim., crassit. 0·006 millim.
Ad saxa arenaria, Dunedin.

19. LECIDEA FUSCO-ATRA, *Ach.*, *Nyl. Lich. Scandin.* p.229. Hypothallus niger, bene visibilis, areolis substratus et interstratus.
Ad saxa basaltica frequens, Dunedin.

* Notis in ea definitione datis (forma apotheciorum sæpe nonnihil irregularis) et præsertim sporis differt a *pulverea*, Borr.

† Est species sporis accedens ad *Lecideam vesicularem*, apotheciis ceteroquin ad *Lecideam aromaticam*.

20. LECIDEA PETRÆA, *Flot.*, *Nyl. Lich. Scandin.* p. 233. Sporæ 8næ, nigricantes, submurali-divisæ, longit. 0·025–0·035 millim., crassit. 0·010–0·012 millim.

Ad rupes micaceo-schistosas, Dunedin.

21. LECIDEA STELLULATA, *Tayl.* Sporæ fuscæ, 1-septatæ, longit. 0·009–0·012 millim., crassit. 0.005–0·007 millim.

Ad saxa basaltica, Dunedin.

22. LECIDEA MYRIOCARPA (*DC.*), *Nyl. Lich. Scand.* p. 237. Thallus cinerascens, tenuis, rugulosus, effusus; apothecia nigra, plana, minuta, marginata; sporæ fuscæ, 1-septatæ, longit. 0·011–0·016 millim., crassit. 0·006–0·007 millim.; paraphyses apice clava fusco-nigra vel nigricante; hypothecium fuscum.

Ad corticem arborum et ad saxa, Dunedin.

23. LECIDEA LENTICULARIS, *Ach.*, *Nyl. Lich. Scandin.* p. 242. Apothecia parvula, intus pallida; sporæ 8næ, incolores, 1-septatæ, longit. 0·011 millim., crassit. 0·0035 millim. Gelatina hymenæa iodo cærulescens.

Ad saxa basaltica, Dunedin.

24. LECIDEA GROSSA, *Pers.*, *Nyl. Lich. Scandin.* p. 239.

Ad cortices arborum et supra vegetabilia destructa, Dunedin.

25. LECIDEA FLAVIDO-ATRA, *Nyl.* Thallus flavidus, sat tenuis, rugulosus, rimosus; apothecia atra, exserta, majuscula (latit. 0·9–1·4 millim.), plana, marginata; sporæ 8næ, incolores, ellipsoideæ, biloculares (sæpe tubulo loculos jungente), longit. 0·034–0·038 millim., crassit. 0·018–0·021 millim.; paraphyses gracilescentes; epithecium et hypothecium fusco-nigra. Gelatina hymenæa iodo intense cærulescens*.

Ad corticem arborum, Dunedin.

26. LECIDEA OXYSPORA (*Tul.*), *Nyl. Lich. Scandin.* p. 246. Sporæ 8næ, incolores, fusiformi-ellipsoideæ, longit. circiter 0·020 millim., crassit. 0·007 millim.

Ad saxa basaltica supra thallum *Parmeliæ conspersæ*, Dunedin.

Trib. XIII. GRAPHIDEI.

1. OPEGRAPHA AGELÆOIDES, *Nyl.* Facie fere (quoad apothecia) *Opegraphæ agelææ* vel *abbreviatæ*, Fée, longioris, sed macula thallina alba vel albida et sporæ (incolores fusiformes) 5-(rarius 7-)septatæ, longit. 0·018–0·027 millim., crassit. 0·0055–0·0065 millim. Gelatina hymenæa iodo vinose rubens.

Ad cortices arborum, Dunedin.

2. OPEGRAPHA SPODOPOLIA, *Nyl.* Thallus obscure cinereus vel fusco-cinerascens, tenuis, opacus, rimulosus, determinatus vel subdeter-

* Prope *Lecideam grossam* locum habeat. Spermogonia a me non visa.

minatus, interdum tenuiter obscure limitatus; apothecia nigra, fere mediocria, linearia (longit. 0·3–1·5 millim. et quidem ampliora), simplicia, sæpius nonnihil flexa, epithecio angustato, intus pallida; sporæ 8næ, incolores, fusiformes, 5–7-septatæ, longit. 0·025–0·030 millim., crassit. circiter 0·007 millim.; paraphyses non discretæ; hypothecium incolor. Gelatina hymenæa iodo vinose fulvescens vel rubescens. Comparanda cum *Opegrapha agelæoide*, sed sæpius nonnihil major et hypothecio incolore.

Ad saxa basaltica, Dunedin.

3. OPEGRAPHA SUBEFFIGURANS, *Nyl.* Thallus vix ullus; apothecia latissime conspersa, nigra, maculiformia (latit. 0·7–1·5 millim.), rotundata, rugoso-effigurata vel interdum fere placodioideo-astroidea, epitheciis rimiformibus (sæpe parum conspicuis) quasi composita; sporæ 8næ, fuscæ, oblongo-ovoideæ, 1-septatæ (sæpe ad septum subconstrictæ), longit. 0·017–0·021 millim., crassit. 0·007–0·008 millim.; paraphyses non discretæ; hypothecium incolor. Gelatina hymenæa iodo cærulescens*.

Ad corticem ("on bark of the Totara Pine"), Dunedin.

4. PLATYGRAPHA LONGIFERA, *Nyl.* Similis fere *Platygraphæ phlyctellæ*, sed sporis gracilioribus longioribusque 7–11-septatis, longit. 0·062–0·080 millim., crassit. 0·005–0·006 millim. Gelatina hymenæa iodo haud tincta. Thallus albus, tenuis, indeterminatus, subopacus, rimosus; apothecia nigricantia, minuta vel punctiformia, suburceolata, intus incoloria.

Ad corticem arborum, Dunedin.

5. ARTHONIA EXCEDENS, *Nyl. Novo-Granat.* ii. p. 106. Sporæ fuscescentes, ovoideæ, 5-septatæ, longit. 0·027–0·032 millim., crassit. 0·010–0·012 millim. Apothecia fusco-nigra vel nigra.

Ad cortices arborum, Dunedin.

6. ARTHONIA PLATYGRAPHELLA, *Nyl.* Thallus albus, tenuis vel tenuissimus (passim rimulosus); apothecia nigricantia, albo-cæsio pruinosa, rotundata, vel oblonga (latit. 0·3–0·6 millim.), planiuscula, margine thallino tenui vel obsoleto lateribus cincta, intus obscura; sporæ 8næ, incolores, oblongo-ovoideæ, 3-septatæ, longit. 0·013–0·016 millim., crassit. 0·005 millim.; thalamium fuscescens; hypothecium fuscum. Gelatina hymenæa iodo vinose rubens†.

Ad corticem eundem ac *Opegrapha subeffigurans*.

* Pertinet ad stirpem *Opegraphæ lentiginosæ* sed facies mycoporoidea et fere *Mycoporum*. Apothecia jam sparsa jam magis conferta.

† *Arthonia albopulverea*, Nyl., Algeriensis comparanda differt forma apotheciorum, sporis crassioribus, etc. In collectione Doctoris Lauder Lindsay adest e Botany Bay ad ligna sicca *Arthonia stictoides*, Desmaz., Nyl. Prodr. Gall. Alger. p. 167.

7. Arthonia conspicua, *Nyl. Novo-Granat.* p. 67, ed. 2. p. 101; Myriangium inconspicuum, *Bab. New Zeal.* p. 46, t. 128 b.
Ad cortices arborum, Dunedin.

Trib. XIV. Pyrenocarpei.

1. Verrucaria pallida (*Ach.*), *Nyl. Pyrenoc.* p. 20; *Lich. Scandin.* p. 268. Sporæ 2næ, fuscæ, murali-divisæ, longit. 0·055–0·100 millim., crassit. 0·024–0·034 millim.
Supra terram in fissuris rupium micaceo-schistosarum, Dunedin.

2. Verrucaria nitida, *Schrad.*, *Ach.*, *Nyl. Pyrenoc.* p. 49; *Lich. Scandin.* p. 279, et quoque var. nitidella, *Flk.* Sporæ longit. 0·014–0·022 millim., crassit. 0·007–0·010 millim.
Ad cortices arborum, Dunedin.

3. Verrucaria glabrata, *Ach.*, *Nyl. Pyrenoc.* p. 47. Sporæ longit. 0·016–0·023 millim., crassit. 0·007–0·011 millim.
Ad cortices arborum, Dunedin.

4. Verrucaria epidermidis, var. punctiformis (*Ach.*), *Nyl. Lich. Scandin.* p. 281. Omnino similis formæ europææ. Sporæ incolores, ovoideo-oblongæ, 1-septatæ, longit. 0·016–0·021 millim., crassit. 0·0045–0·0050 millim.; paraphyses nullæ.
Ad corticem fruticum, Dunedin.

Letter from Swinburne Ward, Esq., to Sir William Hooker, F.R.S.

My dear Sir William.—I am afraid that you will think that I have rather neglected "the interests of science" of late, and forgotten your commissions with respect to the Coco de Mer.

I have just returned from a rather protracted visit to Praslin Island, and have done a portion of what you required,—a portion only, I regret to say, in consequence of local difficulties. By the first opportunity from here I shall despatch to Mauritius, for conveyance round the Cape to Kew, a stem and socket of a full-grown Coco de Mer. I have not had it sawn vertically as you suggested, as its transport can be easily accomplished in one piece, and the operation can be equally well performed at home. I hope it will afford you some further information. I have left about two or three feet of the stem of the Palm; a larger quantity would have been cumbersome; and what remains will, I think, be sufficient for the "interests of science." I had to choose a small tree, a female, about 30 feet in height, but in full vigour. It was situated on the property of the individual described in my despatch

on the subject of the destruction and preservation of the Lodoiceæ, a copy of which was forwarded to the Linnean Society; and it was necessary to select a tree contiguous to the beach, so that there might be less difficulty in getting it into a boat for conveyance to Port Victoria. I had not, therefore, many to choose from; and all the finest specimens are situated in almost inaccessible clefts in the rocky hills that surround the property. The owner of the property informed me that it was useless uprooting any of the younger trees (those of tender years, at least) the stems of which had not appeared above ground. Until the stem appears (according to his statement) the socket is unformed, and the whole base of the uprooted tree rots quickly on exposure to the air. I am not, however, perfectly satisfied on this point; the socket must have a commencement; but, as is the case with many of the Palm-tribe, the base probably, though still progressing, is still in a soft, fleshy condition, and apt to decay rapidly.

One tree, cut down not long ago on this property, measured 186 feet, including the leaves. I had no idea they ever attained so great a height. Two specimens standing close to the house in which I was living, and which I measured roughly, could not have been less than 150 feet. They were both males, quite straight, equal in height and with most luxuriant tops, situated on a piece of open, marshy ground, of about four acres in extent, with nothing but sedgy grass around their bases.

Praslin, altogether, is a lovely little island, very rocky, but nevertheless covered with dense vegetation, principally *Casuarina* on the hills, but with fine timber-trees on the "plateau" below—*Tacamaca, Terminalia, Catappa, Hibiscus populneus* (?), and what are called here Bois de Rose and Bois Blanc, both white woods, much used for lining houses, ceilings, &c. Oranges might be most successfully cultivated in many parts of the island, as wild Citrons, Limes, Lemons, Biggerrades, and Vangasai are very abundant in all the sheltered valleys. The marshes are capable of producing sufficient rice to supply all Seychelles; but next to nothing is now grown, and rice is now selling here at seven dollars a bag! It is very difficult to get these indolent people to do anything to help themselves; so long as they get a meal they take no heed for the morrow, and life is so easy here that absolute poverty is quite unknown.

I must apologize for troubling you with such a long letter, especially when I have so little to communicate.

I will ask Sir Henry Barkly to forward the Coco-de-Mer bulb

from Mauritius. It is too heavy to go per P. and O. steamer. I propose sending you, by next mail, specimens of the leaves in their different stages of preparation for working up. My sister tells me that some of the little baskets are already in Kew Museum, but that the raw material is wanting.

Believe me, my dear Sir William,

Yours very truly,

SWINBURNE WARD.

On two Species of Guttiferæ. By THOMAS ANDERSON, M.D., F.L.S., Superintendent of the Royal Botanical Gardens, Calcutta.

AMONG many rare species cultivated in the Botanical Garden of Calcutta, and of most of which specimens have escaped the devastation of the cyclone of the 5th October last, are two species of Guttiferæ of considerable interest. The first of these, *Calysaccion Siamense*, Miq. (*Mammea Birmannica*, mihi), was raised from seed sent from Thyat Mew in Burmah, in May 1854, by Mr. R. Scott, Head Gardener of the Botanical Garden. Several plants were procured from this seed; and in 1863, two of them produced flowers. They were then drawn, and I described them as *Mammea Birmannica*. The same trees flowered again in March 1864. Although one of them was seriously injured by the storm of the 5th of October, three specimens still exist in the Garden.

This species was also discovered in Siam, near Bangkok, in 1862, by Mr. Tejsmann, the Director of the Botanical Garden of Buitenzorg, in Java; and some of the specimens collected by him were sent to Professor Miquel and myself. Here these specimens were recognized as belonging to my *Mammea Birmannica*, while Professor Miquel described those sent to him as *Calysaccion Siamense*. *Vide* 'Annales Musei botanici Lugduno-Batav.' i. p. 209.

The two trees that flowered here have as yet produced only staminiferous flowers; and the specimens collected by Mr. Tejsmann have also flowers with stamens only. The description I have given of the species therefore differs from that by Professor Miquel, in so far as I have been enabled to add somewhat to his description from my having before me living trees of the species.

MAMMEA SIAMENSIS, *T. Anders.* Erecta, ramis abbreviatis; foliis coriaceis, breviter petiolatis, oblanceolatis vel anguste cuneatis, apice obtuse rotundatis, rare emarginatis, margine integerrimis, supra nitidis, viridibus, subtus pallidis, pulcherrime et minutissime reticulatis;

floribus masc. axillaribus, solitariis seu geminis vel rare fasciculatis; pedunculis crassis, patentibus vel deflexis; sepalis 2, herbaceis, ovatis, inflexis, apice mucronulatis, glabris, eveniis; petalis 4, pellucidis, ovatis, apice rotundatis, reflexis; staminibus numerosis, filamentis elongatis patentibus, antheris bilocularibus anguste oblongis.—Calysaccion Siamense, *Miq. in Annal. Mus. Bot. Lugd.-Bat.* i. p. 209.—Mammea Birmannica, *T. Anders. MS.*

Hab. prope Thyat Mew, ad pedes jugi collium provinciæ Arracan, *R. Scott hortulanus primarius horti botanici Calcuttensis, atque inde in horto botanico Calcuttensi culta.* In Siam, prope Bangkok, *Tejsmann* !

Arbor humilis, ramosa. *Rami* breves, simplices, adscendentes, ad partes veteres defoliati. *Cortex* rugosus, cinereus. *Folia* viridia, coriacea, supra nitida, minute penninervia, ad nervum medium canaliculata, subtus pulcherrime crebre reticulata nervo medio prominente, flava, 4–6 unc. longa, 1–2½ unc. lata, petiolo crasso ½ unc. longo. *Flores masc.* plerumque e portione defoliata ramorum orientes, fugaces, odorem foliorum siccorum *Camelliæ Theæ* emittentes; pedunculo unifloro, tereti, 1 unc. longo. *Calyx* ante anthesin clausus; alabastro obovato, viridi, apice mucronato. *Sepala* petalis breviora, reflexa, apice involuta, 4 lin. longa. *Stamina* petalis longiora; filamentis glabris, apice undulatis; antheris oblongis, aurantiaco-flavis, longitudinaliter dehiscentibus. Flores cèteri ignoti.

Mr. Tejsmann says that the Siamese make necklaces of the flowers and also offer them to the images of Boodh.

The other species of this order is a *Garcinia* from the eastern coast of Africa. Besides the interest attaching to the plant as a member of a flora of which comparatively little is known, the species is remarkable on account of its very peculiar habit, and also, though a true *Garcinia*, for its departure from one or two of the characters of the genus. The plants in the Botanical Garden were obtained from seeds sent to Dr. Thomson in 1859 by Dr. Kirk of the Zambesi expedition. Six young trees have been planted in the Botanical Gardens, and several specimens have been sent to some of my correspondents. Since the commencement of this year, one small tree has produced a great profusion of pseudo-hermaphrodite flowers; and for the last three weeks another tree has borne a few flowers, all of which are of the same character as those of the first tree. This fruitless flowering occurs among other species of Guttiferæ while in a young state, or at least during the first years of flowering; fruit-producing plants being those only that have arrived at full maturity.

GARCINIA LIVINGSTONEI, *T. Anders. MS.*

Erecta, glabra, ramis abbreviatis, simplicibus, patentibus, decussatim oppositis vel ternatim verticillatis; foliis coriaceis, subsessilibus, oblongis, ellipticis, rare ovatis apice rotundatis, mucronulatis, basi subcordatis, margine undulatis, crustaceis, reticulatim pinnatinerviis; petiolo brevissimo, crasso, supra umbone triangulari notato; *floribus pseudo-hermaphroditis* axillaribus, solitariis vel 2–5 fasciculatis; pedunculis unifloris, patentibus; sepalis herbaceis 4, in æstivatione decussatim imbricatis, per paria oppositis; petalis 5, æstivatione valvatis, rotundatis, basi late et breviter unguiculatis, reflexis, apice cucullatis, margine integris, interdum dentatis; staminodiis in disco biseriatim insertis, liberis, erectis, patentibus, disco annuloso, cereo, corrugato; stigmate sessili, peltato; ovario compresso, biloculari, basi disco cincto, loculis uniovulatis. [*Fl. masc.* Staminibus indefinitis, numerosis, liberis, filamentis crassiusculis in disco crasso centrali singulatim insertis, antheris parvis oblongis peltatim affixis bilocularibus, loculis longitudinaliter dehiscentibus; ovarii rudimento 0.—D. O.]

Hab. in rupibus schistosis prope flumen Zambesi, *D. Kirk*, in horto botanico Calcuttensi ex Africa culta.

Arbor parva, pyramidalis, succo flavo, viscido. *Caulis* inferior robustus, superior gracilis, fere virgatus. *Cortex* cinereus, fissus, rugosus. *Folia* caulina plerumque decussatim opposita, rare ternatim verticillata, ramorum semper ternatim verticillata, coriacea, supra atroviridia, albivenosa, 3–7 unc. longa, 2–3 unc. lata.

Flores pallide virides, suaveolentes, odorem *Vanillæ* emittentes; alabastro globoso. *Calyx* corolla multo brevior, in anthesi petalis reflexis obtectus, sepalis concavis. *Corolla* semper 5 petalis; petalis conformibus, 3 exterioribus, 2 interioribus. *Discus* cereus, flavus. *Staminodia* 15–20, distincta, filamentis filiformibus; antheris globosis, crustaceis.

[Fructus drupaceus, magnitudine Juglandis nucis, 1–2-spermus, mesocarpio pulposo, epicarpio tenui lævi; embryone ellipsoideo, tereti, utrinque obtusissimo, sublævi v. granulato-ruguloso, e radicula crassa (tigella) carnosa constante, cotyledonibus 0.—D. O.]

Dr. Livingstone says that the natives about the Zambesi eat the fruits; they are about the size of a walnut.

Postscript by Professor OLIVER. (Nov. 1865.)

From the specimens collected on the Zambesi by Dr. Kirk, and the careful drawings and analyses made upon the spot by this gentleman, and liberally presented by him to the Kew Herbarium, I have been able to supply some gaps in the above description of this interesting plant. In working up the few Guttiferæ of Tropical Africa for the proposed flora of that region now in preparation, I have included this plant in the genus *Garcinia*, though

not without some hesitation. This course appeared preferable to either of the alternatives—of referring it to *Rheedia* or erecting it into a new genus. The difficulty arises principally from the number of parts in the floral envelopes, whether we regard the two outermost leaves as sepals or bracteoles. Whatever we call them, however, we have a noteworthy departure from the characteristic symmetry of *Garcinia* proper, in which the calyx consists of two decussating pairs of sepals, and the corolla of four petals alternating with the sepals.

Enumeration of Indian *Lemnaceæ*. By Mr. Sulpiz Kurz, Curator of the Herbarium of the Royal Botanical Gardens, Calcutta. Communicated by Dr. Anderson, F.L.S., Director of the Royal Botanical Gardens, Calcutta.

(Plate V.)

[Read November 2, 1865.]

In submitting the description of a new kind of duckweed, I have thought it not uninteresting to give at the same time a general enumeration of all the *Lemnaceæ* which, so far as I am acquainted with them, occur in India and the adjacent archipelago.

This new species, which I call *Lemna oligorrhiza*, shows such a similarity in the structure of the fronds to *Spirodela polyrhiza*, that I found it necessary, after examination of the flowers, to connect *Spirodela* again with *Lemna*. *Telmatophace* possesses the habits of *Wolffia*, but is apparently essentially the same as *Lemna*. As I have never had sufficient material for a minute examination of its flowers, I prefer keeping the genus distinct for the present.

Duckweeds occur nearly as generally in the tropics as in northern countries, though a moist region, covered with tanks and rivers, is more favourable to them than a dry one. Bengal is, therefore, very rich, not only in species, but also in the number of the individuals. A remarkable diminution of them can very evidently be observed in travelling from Calcutta to the dry districts of Behar near Parasnath, about 200 miles distant.

I possess little information about the vertical distribution of these small waterplants in India, but it seems to be certain that the individuals and species numerically decrease as we ascend the mountains. In Java, at 5000 feet above the sea, and even where lakes and pools of water are numerous, scarcely any duckweeds are found. This is the more remarkable, as nearly all the species are found both far to the north and south of the globe. In

Laboul *Lemna minor*, the only species known in that district, ascends to 9500 feet (see specimens collected by Dr. Brandis).

In working out this small group, I am principally indebted to Dr. T. Anderson for his liberal permission, not only to use the herbarium and library at the Royal Botanic Gardens, Calcutta, but also his private collection.

I. WOLFFIA, *Hork. et Schleid.*

(Grantia, *Griff.*; Horkelia, *Rchb.*)

Inflorescentia centralis. *Flos masc.* 1. *Ovarium* 1-ovulatum. *Utriculus* monospermus.

Herbulæ minimæ, rarissime (in spec. Africanis) magnæ, natantes, sæpius arrhizæ, frondiculis subtus cellulose bullatis.

1. WOLFFIA DELILII, *Schleid. in Linn.* xiii. 389; *Wedd. Sc. Nat.* 3 ser. xii. 170; *Walp. Ann.* iii. 496.

Frondiculæ arrhizæ, ¼ lineæ longæ, oblongo-globosæ, supra stomatiferæ convexiusculæ, subtus globoso-efflatæ, laxe irregulariterque hexagono-cellulosæ, hyalinæ.

Hab. Very common throughout Bengal! and probably through the whole of India.

Distr. Egypt; Eastern Java!

Var. *a. Delilii*, frondiculis duplo triplove majoribus, superficie magis suboperculiformi discretâ.

Lemna hyalina, *Del. Æg.* 27.

Lemna arrhiza, *Willd. herb.* 17141.

Grantia globosa, *Griff. Notul. Monocot.* p. 229, t. 267. ii.

Var. *β. Schleideni*, frondiculis ¼ lin. magnis, magis cylindricis, superficie sæpius convexiusculâ.

Wolffia Schleideni, *Miq. in Ned. Kruidk. Arch.* iii. 428; *Fl. Ind. Bat.* iii. 221.

Lemna globosa, *Rab. Fl. Ind.* iii. 565.

Both these forms occur in Bengal. I cannot find any specific distinction; they are merely varieties.

TAB. V. fig. 7, plants of the variety *a*, natural size; figs. 8, 9, id. magnified; fig. 10, plants of the variety *β*, natural size; figs. 11, 12, id. magnified.

2. WOLFFIA MICROSCOPICA, *Kurz.* Frondiculæ lineam vix excedentes, ecllulosæ, supra planiusculæ, subtus in radiculam (?) subcylindricam productæ; pollen glabrum (sec. *Griffith*).

Grantia microscopica, *Griff. Not. Monocot.* 226, t. 266-268.

Hab. Bengal, *Griffith.*

I have not yet seen this species, which seems to be a rare one.

II. TELMATOPHACE, *Schleid.*

Inflorescentia lateralis. *Flores masc.* 2. *Ovarium* 2-∞-ovulatum. *Capsula* membranacea, circumscisse dehiscens.

Plantulæ majusculæ, natantes, frondiculis subtus cellulose efflatis, 1–oligorrhizis.

1. TELMATOPHACE GIBBA, *Schleid. in Linn.* xiii. 391; *Kth. En.* iii. p. 6.

Lemna gibba. *Lin. Sp.* pl. 1377; *Wolf. Monogr.* 26, f. 11–15; *Willd. Sp. Pl.* iv. 195; *Schk. Handb.* iii. t. 281; *Engl. Bot.* t. 1233; *Fl. Dan.* t. 1588; *M. B.* ii. 610; *Mert. et Koch, Germ.* i. 295; *Rich. in Guill. Arch.* i. 200, t. 6; *N. E. Gen.* vi. t. 9. f. 13–19; *Brongn. in Guill. Arch.* ii. 99, t. 12. f. 2 (fruct. et sem.); *Wilson, in Hook. Bot. Misc.* ii. 145, c. tab. (germinat.); *Koch, Syn. Germ.* 681; *Kth. Berol.* ii. 301; *Blanco, Fl. d. Filip.* 672 (?).

Lenticula vulgaris, *Lam. Gall.* ii. 189.

Lemna vulgaris β, *Lam. Encycl.* iii. 464.

Distr. Europe!; Caucasus; Egypt; Canarian Islands; Amer. bor. et æquator.!; Philippines?

This species seems not yet to have been found in India, but occurs probably in North-western India. Loureiro's *L. gibba* may perhaps be the same as *L. minor.*

Seemann's *L. gibba*, No. 656, from the Fiji Islets, seems to be a new species; and, with reference to the number of roots, it stands in the same relation to *T. gibba* as my *L. oligorrhiza* to *L. minor.*

III. LEMNA, *Lin.*

Inflorescentia lateralis. *Flores masc.* 2. *Ovarium* 1–2-ovulatum. *Utriculus* 1–2-spermus, indehiscens.

Herbulæ natantes v. submersæ, frondiculis planis v. convexiusculis mono- polyrrhizis.

§ 1. *Genuinæ.* Frondiculæ 1–polyrrhizæ, natantes. (*Lemna*, Schleid.; *Spirodela*, Schleid.)

1. LEMNA MINOR, *Lin. Spec. Pl.* 1376; *Wolf. Monogr.* 23, f. 4–10; *Willd. Sp. Pl.* iv. 194; *R. Br. Prodr.* 345; *M. Bieb. Flor.* ii. 378; *Engl. Bot.* t. 1095; *Fl. Dan.* t. 1587; *Mert. et Koch, Germ.* i. 295; *N.E. Gen.* 6, t. 9. f. 1–12; *Brongn. in Guill. Arch.* ii. 98, t. 12. f. 1 (fruct.); *Koch, Syn. Germ.* 681; *Kth. Berol.* ii. 301; *Schleid. in Linn.* xiii. 390; *Hassk. Tydsch. N. Gesch.* x. 123; *Zoll. Cat.* p. 75; *Plant. Jungh.* i. 169; *Kth. En.* iii. 4; *Miq. Fl. Ind. Bat.* iii. 221; *Hook. Fl. Tasm.* ii. 38; *Hegelm. in Seem. Journ. of Bot.* 1865, p. 112.

Lenticula palustris, *Vaill. Paris*, t. 20. f. 3.

Lenticula minor, *Scop. Carn.* no. 1142.

Lenticula cyclostasa, *Elliott.*

Lenticula minima, *Humb. et Kth. Nov. Gen.* i. 372.

Lenticula minor *a.* minima, *Chev. Paris*, ii. 256.

Lemna conjugata, *Willd. herb.* 17143.

Hab. All over India and the Indian archipelago; Bengal!, flowers here in March abundantly; Khasya, 6000′, *J. D. H. et T. T.*! Ceylon, *Thwaites*; Peshawar valley, abundant, *Dr. Stewart*; Western Tibet,

7000′, *T. T.*!; Khudly, valley of the outer Himalayas, *Dr. Brandis*!; Kocksar in Laboul, 9500′, *Dr. Brandis*!; Western Java, common from the plains to the base of the hills, 3000′!; Singapore and Bangka!; Celebes!; Fiji, *Seemann*, no. 657!, etc. etc.

Distr. Cosmopolitan.

Lemna minor, Griff. Notul. Monoc. p. 216, t. 262 et 263, is described and figured as having "pollen læve." The hyaline margins are of less importance. I have examined the flowers of a great quantity of specimens from Bengal, which quite agree otherwise with Griffith's figure; but I never could observe pollen as quoted by him.

2. LEMNA OLIGORRHIZA, *Kurz.*

Frondiculæ planæ, tenuiusculæ, suboblique oblongæ v. obtusiusculæ, 2–3-rhizæ, subtus purpureæ.

Frondiculæ in series circinatas concatenatæ, 3–4 lin. longæ, $1\frac{1}{2}$–2 lin. latæ, texturâ tenui, supra saturate virides, nitentes, 1–3-striatæ. Radices binæ, sæpe ternæ, flavidulæ v. viridiusculæ, flaccidæ, longissimæ. Flores ut in *Lemna minore*, sed filamentum antheræ provectioris paullo brevius. Pollen granulosum. Ovarium 2-, rarissime 1-ovulatum, rosellum.

This species seems to be scarce in Bengal; I found it only in a tank near Seebpore, and in a water-course of the Botanic Gardens, Calcutta, and there always in company with *L. polyrrhiza.*

I was inclined for some time to look upon this species as an extreme variety of *L. polyrrhiza*; but since I got the flowers, I consider it distinct. It has the size and general form of *L. minor*, but the bright green surface and purple-coloured undersurface of *L. polyrrhiza.*

TAB. V. fig. 1. plants, natural size; f. 2. id. magnified; f. 3. id. from beneath; f. 4. flowering frond from beneath; f. 5. inflorescence; f. 6. pollen.

3. LEMNA POLYRRHIZA, *Lin. Sp. Pl.* 1377; *Wolff, Monogr.* 28, t. 16–21; *Willd. Sp. Pl.* iv. 195; *Schk. Handb.* iii. t. 381; *Engl. Bot.* t. 2458; *Fl. Dan.* ii. 610; *Mert. et Koch, Germ.* i. 296; *Koch, Syn. Germ.* 680; *Sturm, Heft.* 44; *Kth. Berol.* ii. 302.

Spirodela polyrhiza, *Schleid. in Lin.* xiii. 392; *Kth. En.* iii. 7; *Miq. Fl. Ind. Bat.* iii. 222, *et in Zoll. Cat.* 75.

Lenticula palustris major, *Vaill. Paris,* t. 20. f. 2.

Lenticula polyrhiza, *Lam. Gall.* ii. 189.

Lemna bannatica, *Waldst. et Kit.*

Lemna orbicularis, *Kit. in Schult. Flor.* ed. 2. 64; *Rchb. Germ.* 138.

Lemna thermalis, *P. d. B. in Nutt. Gen.* i. 19.

Lemna orbiculata, *Rxb. Fl. Ind.* iii. 365.

Lemna major, *Griff. Not. Monoc.* 216, t. 264.

Hab. Common all over Bengal!; Ceylon, *Thwaites*; Shanghai, *D. Maingay*, no. 674!; Java,

Distr. Europe!; Egypt; Asia; North America.

Var. *β. concolor,* frondiculis multo majoribus apice acutiusculis utrinque læte viridibus.

This pretty variety occurs in Bengal occasionally, in very clear water, under the shade of trees.

§ 2. *Staurogeton.* Frondiculæ monorrhizæ, cruciatim connatæ, submersæ. (*Staurogeton*, Rchb.)

4. Lemna trisulca, *Lin. Sp. Pl.* 1376; *Wolff, Monogr.* 20, t. 1–3; *Willd. Sp. Pl.* iv. 193; *R. Br. Prodr.* 345; *Hook. Fl. Tasm.* ii. 38; *M. Bieb. Flor.* ii. 378; *Engl. Bot.* t. 926; *Flor. Dan.* t. 1586; *Mert. et Koch, Germ.* i. 294; *Koch, Syn. Germ.* 680; *Kth. Berol.* ii. 300; *ejusd. En.* iii. 5; *Schleid. in Linn.* xiii. 391; *Miq. Fl. Ind. Bat.* iii. 222.

Lenticula trisulca, *Scop. Carn.* no. 1143.

Staurogeton, *Rchb. Consp.* 44.

Lemna intermedia, *Rathe.*

Lemna cruciata, *Rxb. Fl. Ind.* iii. 566.

Hab. Bengal, common in standing waters!; Peshawur valley, common, *Dr. Stewart*; Indian archipelago?

Distr. Europe!; Asia; North America.

Species excludenda.

Lemna obcordata, *Ham. Herb. in Wall. Cat.* 5201: Marchantiaceæ.

On *Arthonia melaspermella*, Nyl., nov. sp. By W. Lauder Lindsay, M.D., F.R.S. Edin., &c.

(Plate VI.)

[Read Dec. 7, 1865.]

This minute and obscure Lichen possesses several features of considerable interest to botanists. Not only is it a species new to science and an addition to the Lichen-flora of Britain; but it is a good type of a group of dubious organisms, having the characters of both Fungi and Lichens, now classed in the one order, now in the other, according to the varying views of Fungologists and Lichenologists.

Inasmuch as I know of no certain or satisfactory means of distinguishing many of the lower Lichens from many of the lower Fungi, and until, at least, botanists have discovered some diagnostic characters of a sufficient kind, I think it would be well to classify plants so dubious in their characters in a transition or

intermediate order of *Fungo-lichenes* *, to be composed avowedly of plants possessing the characters of both Lichens and Fungi, and which, in virtue of this double character, cannot be well grouped in either of these grand orders. As so constituted, the *Fungo-lichenes* would form a large and heterogeneous group; but it would serve the purpose of assembling in one mass or family, however diverse in the characters of its members, organisms which are now lost sight of in the ranks either of Fungi or Lichens, and whose true character is really most imperfectly known. With the progress of microscopic research and the multiplication of earnest students of the Fungi and Lichens, the proper affinities of many of them would probably soon lead to their extradition from the *Fungo-lichenes*, and their classification among the Fungi or Lichens proper. But it will be long (if ever), I fear, before the line of distinction between the lowest Fungi and Lichens becomes so well marked as to admit of the abolition of so useful a provisional order.

In like manner it would be convenient to retain an order (*Algo-lichenes* †) for genera such as *Lichina*, *Nostoc*, *Myriangium*, and *Collema*, which partake of the characters both of *Algæ* and *Lichenes*, for certain groups at least of the *Palmellaceæ* [forms of *Protococcus*] which appear to be the rudimentary conditions of certain lichens, and for dubious genera such as *Chroolepus*, *Chrysothrix*, *Sirosiphon*, and *Cilicia*.

The plant which forms the text of the preceding and following remarks (*Arthonia melaspermella*, Nyl., nov. sp.) was first sent to me in 1858 by my friend Mr. Currey, the eminent Fungologist, who accompanied his specimens with the following interesting information, comprising all I know of its history and geographical distribution.

He describes it as "a doubtful plant, which seems to hover between the Fungi and the Lichens. . . . . I may mention," says he, "that I have had very different opinions upon the plant from different correspondents. Mr. Broome tells me he has often

* I must not be held as using this term in any other sense than that here indicated. A similar term has been employed in other senses by Lichenologists, *e.g.* by Krempelhuber, whose *Myco-lichenes* is a synonym of the *Caliciaceæ* of other authors (Die Lichenen-Flora Bayerns, p. 85). Under the title "*Pseudo-Lichenes*," he classes (p. 86) certain of the genera hereinafter referred to, viz. *Abrothallus*, *Celidium*, *Scutula*, *Tichothecium*.

† This view is fully, perhaps too fully, developed, in "Beitrag zur Flechten-Systematik," by Dr. Stizenberger of Constance (Trans. of the St. Gall. Nat.-Hist. Soc. for 1861, p. 139): *vide* Division of *Phyco-lichenes*.

found it, and always considered it a Lichen. Mr. Berkeley thinks it certainly a *Peziza* of the section *Patellea*; and Mr. Churchill Babington inclines to this view. Mr. Leighton thought at first that it was *Lecidea nigritula*, Nyl. *, but ultimately was disposed to consider it a *Patellaria* . . . . . . My own idea is that it is a *Patellaria*. True Pezizas have not *septate sporidia*, nor *sporidia* of a dark colour; and the structure is more leathery than that of any *Peziza* I know of. . . . . . The plant has a wide range, as I find it also amongst some Fungi from Massachusetts. Mr. Babington suggested a possible affinity with *Biatora campestris*, Fr.† . . . . . The hymenium is tinged blue with iodine . . . . . . I used only a weak solution of iodine, and observed a very manifest blue tinge to be produced by it. There are several Fungi in which the same reaction occurs; so that this test is no longer conclusive between Fungi and Lichens . . . . . . The plant . . . . . . was collected in the neighbourhood of London; and, if I recollect rightly, close to Weybridge, in Surrey." Nylander, the first living authority on the classification and nomenclature of Lichens, and the author, moreover, of a monograph of the genus *Arthonia*‡, regards this plant (1865) as an *Arthonia*. For myself, I do not feel satisfied either with its position in the genus *Arthonia*, if it is to be regarded as a Lichen, or with its position among Lichens. I prefer to refer it, provisionally at least, to the *Fungo-lichenes*; classing it under the head of *Lecidiella*, or some similar name, to signify its resemblance, *quoad* its apothecia, to the Lichen-genus *Lecidea*.

The specimens which I submitted to examination were three in number—two from Weybridge, and one from Massachusetts. In all three the plant affects striated or grooved, weathered wood, apparently fabricated timber. There is no visible thallus—the apothecia and pycnides, which constitute the plant, being seated generally in the furrows of the wood, having thus a linear arrangement (in rows). (Pl. VI. figs. 1, 2.)

The apothecia (fig. 2, *a*) are lecideiform, generally exhibiting a roundish, flat, thin disk, with a very thin, frequently wavy or corrugate margin, both of a pitch-black colour; but occasionally

* The plant certainly has a close resemblance to some athalline forms of *Lecidea nigritula*, Nyl., and *L. myriocarpa*, DC., which also occur on old fabricated timber.

† *Peziza Mougeottii*, Pers.

‡ "Synopsis du genre Arthonia," Mém. de la Société Impériale des Sciences Nat. de Cherbourg, vol. iv. 1856.

the disk is paler or glaucous, resembling in this respect the apothecia of the New Zealand *Lecidea leucothalamia*, Nyl. (fig. 2, *b*). Occasionally the apothecia of the *Arthonia* are subconvex and immarginate, especially under moisture, when the disk swells and absorbs for the time (fills or draws out) the rugose or wavy exciple or margin (figs. 2, 3, *d*). They also exhibit a tendency to become difform, variously elongate or angular (fig. 2, *e*), resembling the apothecia of various *Patellariæ*, e.g. *P. atrata*, Fr. as it occurs in my Herbarium from New Zealand. This elongation or angularity appears to depend, on the one hand, on the irregularities of, or pressure by, the fibres or rugæ of the wood on which the apothecia grow, and, on the other, on the delicacy and tenuity of these apothecia themselves. The *hymenial gelatine* or the thecæ give, with tincture of iodine, a very pale-blue reaction in some cases (fig. 4, *a*); but generally there is no reaction or coloration at all *. The paraphyses (fig. 4, *b*) are very delicate and not easily seen, exhibiting themselves generally as a confused yellowish mass of filiform tubules, without coloured or clavate heads. But in other cases, especially when old, they become subdiscrete, and are then seen to possess bulging or knobbed heads (fig. 4, *c*). The thecæ (*a*) are short, obovate, and 8-spored, having the saccate character of those common in the genus *Arthonia*, about ·0012 inch long, and ·0003 to ·00045 broad. The spores (fig. 5) are brown, 1-septate, soleæform (that is, with the upper half, or locule, shorter and broader than the lower), arranged in the thecæ with the broader end upwards (fig. 4, *a*), very small, varying in length from ·00030 to ·00045, and in breadth from ·00012 to ·00014. There are no spermogones; but their place seems to be taken by pycnides (fig. 2, 3, *c*), which externally resemble the usual spermogones of *Arthonia*, in being very minute, black, punctiform conceptacles, mostly semiimmersed in the wood, scattered among the apothecia, generally outside the region occupied by them. The stylospores (fig. 6, *a*) are about ·0006 to ·0009 long, and ·00012 broad, and are the terminal articulations of short, linear, jointed, sterigmata, of a bluish tint (*b*).

In systematic works I do not find any reference to pycnides in the genus *Arthonia*. But in 1856–58 I not only found them in

* It will be observed that my experience differs here somewhat from that of Mr. Currey. This may have arisen from various causes, such as the different strengths of the preparations of iodine used, or the comparative freshness or age of the plant when examined.

two or three species, but I occasionally met with as many as *three forms of spermogone in the same species*—an instructive illustration of *polymorphism in the fructification of Lichens*, a subject of such physiological interest that I purpose returning to it in detail, and devoting thereto a special essay.

Externally the pycnides of *Arthonia* resemble the spermogones in being very minute, brown or black, punctiform papillæ, partly immersed, scattered over the thallus and among the apothecia. They occurred, for instance, in the following species :—

I. *Arthonia astroidea*, Ach., var. *Swartziana*, Ach. (Pl. VI. figs. 9, 10.)

1. Specimens in my Herbarium from Great Island, Cork: Carroll (fig. 9). The thallus here is white and smooth, bounded by a black, irregular hypothallus. The pycnides are thus prominent as largish, irregular, black cones, scattered abundantly outside the region of the apothecia, much larger than the spermogones of the same species. The stylospores (fig. 9, *c*) are brown, irregular in form, which is generally ellipsoid or oblong, sometimes obovate, pyriform, or curved, about ·00015 inch long, and ·000075 broad: borne on the apices of short, simple sterigmata, about ·00045 long (*a*).

2. On ash about Belp, Switzerland : Schærer, Exs. 463 (fig. 10). Here the pycnides occur as small black dots or points, in groups among the apothecia. The envelope or perithecium, like that of the spermogone of the type (fig. 11, *a*), consists of deep-brown, very small, closely aggregated cells. The sterigmata (*a*, *b*) are brown, short, simple, linear (*a*), sometimes branching or spreading below (*b*) [as in *Lichina pygmæa*, Ag., examined by me in Leighton's Exs. 260], varying in length from ·00045 to ·00025 inch. They bear on their apices pale-brown stylospores (*c*), oval or ellipsoid, sometimes pyriform, about ·00006 broad, varying in length from ·00015 to ·00038. In specimens occurring on *Pinus picea* on Mount Gurten, Switzerland (Schær. Exs. 634), I found conceptacles of similar external characters, which seem to be the pycnides of an accompanying very minute *Sphæria*, whose perithecia may be confounded with the pycnides or spermogones of the *Arthonia*. The perithecia of the *Sphæria* are distinguished, however, by their containing sac-like polysporous thecæ; while the stylospores of the pycnides are very small, ellipsoid, simple, and brown.

The spermogones of the type *A. astroidea* (fig. 11), possess very short, simple sterigmata (*b*), and generally atomic, oval or

roundish spermatia (*c*) which, however, are sometimes also rod-shaped*.

II. *Arthonia pruinosa*, Ach., var. *spilomatica*, Fw. (Pl. VI. fig. 7.) On oaks about Lorch, on the Rhine, *Bayrhoffer*; *Schær. Exs.* 507. The pycnides are very small, round, black points, having the characters of certain species of the old genus *Pyrenothea* (*e.g. P. insculpta*, Wallr., *P. stictica*, Fr.). The sterigmata (*a*, *b*) have much the character of those described in specimen No. 2 of *A. astroidea*, being simple and linear (*b*), sometimes branching or spreading below (*a*), colourless, about ·0009 to ·00075 inch long. They give off from their apices stylospores (*c*), which vary considerably in form, size, and colour, and which are generally very abundant. Their colour is usually some shade of pale yellow; their form ellipsoid or oblong, straight or curved; they are simple or 1-septate, hyaline or granular, about ·0003 inch long.

The ordinary spermogones of the type *A. pruinosa* (fig. 8) are generally very abundant, especially on old oaks, in the fissures of the rugged bark, prominent and easily seen when the thallus is pruinose white. The sterigmata are short and simple (*a*); the spermatia in myriads, and more or less ellipsoid or rod-shaped, and simple† (*b*).

This species, however, appears to possess ***several forms of spermogone*** and *pycnide*; some of which are both abundant, or common, and easily seen, and which have been described by the older Lichenologists as species of *Pyrenothea* (*P. gregaria*, Fw.; *Leprantha fuliginosa*, Turn., var. *microsticta*, Fw., Tul. Mém. 192; *P. stictica*, Fr., Körb. Syst. Lich. Germaniæ, p. 294–5). The spermatia are usually described by authors as oval or ellipsoid. There may be some difference of opinion as to whether what I have hereinbefore described as *pycnides* and *stylospores* should not be regarded as *spermogones* and *spermatia*. It appears to me that there is a good *anatomical* distinction (as there may hereafter prove to be an equal *physiological* one) between the corpuscles which I have described here and elsewhere ‡ as *spermatia*

* The specimen figured is from Schærer's Exs. 16. Section of spermogone, greatly magnified, diagrammatic; *a*, envelope or perithecium of dark-brown, small, irregular, closely aggregated cells.

† The specimen here figured is from Nylander's Exs. [Herbarium Lichenum Parisiensium, 1854–5] 83. Sterigmata about ·00045 inch long; spermatia about ·00012 long, and ·00005 broad. Nylander describes the spermatia of the genus *Arthonia* as normally or typically *cylindrical*, and straight (rod-shaped), or curved (Lich. Scand. 257).

‡ Memoir on the Spermogones and Pycnides of Lichens; Trans. Roy. Soc. Edinb. vol. xxii. p. 101.

and as *stylospores*,—the latter being almost invariably larger, broader, more irregular in form, sporoid in their aspect, frequently granular, occasionally coloured, and sometimes septate.

I have found similar pycnides and spermogones (including triple forms of the latter in a single species) in the genus *Opegrapha*.

Certain other *Arthoniæ* resemble *A. melaspermella* in the possession of *lecideiform* or *patellarioid apothecia*: such are *A. trachyloides*, Nyl., in which Mudd points out this peculiarity in its physiognomy *; *A. macrotheca*, Fée, from Guyana, in the Hookerian Herbarium, Kew; and *A. melaleuca*, Nyl. In such forms there has been no little confusion between certain species of *Arthonia* and of the genus *Lecidea*. E. g., forms of *Lecidea parasema*, Ach., var. *punctata*, Ach., have been confounded with *Arthonia patellulata*, Nyl.; *Lecidea dryina*, Rchb. Exs. 71, is *Arthonia melaleuca*, Nyl., which moreover resembles *A. melaspermella* in having brown, and one- (though sometimes also two-) septate spores; A German specimen in the Hookerian Herbarium, Kew, variously labelled *Lecidea dryina*, Ach., *Coniangium vulgare*, Fr., and *Spiloma paradoxum*, Ach., appears referable to *Arthonia lurida*, Ach.; *Arthonia lurida*, Ach. var. *globularis*, Ach., is *Lecidea globularis*, Nyl. Lich. Scand. 213, its hymenial gelatine striking a *blue* with iodine.

The reaction with iodine of the hymenial gelatine in the genus *Arthonia* varies from deep and beautiful blue to the faintest shades of wine-red, being reddish or violet in the majority of species. I found it more or less deep blue (for instance) in *A. macrotheca*, Fée, *A. minutula*, Nyl., *A. dispersa*, Nyl., and *A. astroidea*, Ach. from Ireland (thecæ only), all in the Hookerian Herbarium. It is also intensely blue in *A. minutissima*, Nyl.†

The genus *Arthonia*, as at present established, is a large and heterogeneous one, comprising species formerly referred to the following old or existing genera:—

I. *Lichens*.

1. Graphis, *Adans.*
2. Opegrapha, *Humb.*
3. Lecanactis, *Eschw.*
4. Leprantha, *Duf.*
5. Coniocarpon, *DC.*
6. Coniangium, *Fr.*
7. Spiloma, *Ach.*
8. Pachnolepia, *Mass.*
9. Arthrothelium, *Mass.*
10. Parmelia, *Ach.*
11. Lecanora, *Ach.*
12. Lecidea, *Ach.*
13. Nævia, *Fr.*
14. Trachylia, *Fr.*
15. Verrucaria, *Wigg.*
16. Limboria, *Ach.*
17. Pyrenothea, *Fr.*
18. Myriangium, *Dur. & Mont.*

* Manual of British Lichens, p. 251.

† Lich. Scand. 263.

II. *Algæ.*

19. Cilicia, *Fr.*
20. Chrysothrix, *Mont.**

III. *Fungi.*

21. Patellaria, *Fr.*

It has therefore already absorbed species of genera and families the most diverse; and it seems, indeed, too much a mere convenient receptacle for doubtful species or forms, of whose true character and affinities we have yet insufficient knowledge.

There has ever been a confusion almost inextricable between the *Fungi* and *Lichens* in regard to certain of the more minute, or lower, forms of both. On the one hand, many formerly considered *Fungi* are now regarded as *Lichens*; and on the other, many *Lichens* as *Fungi*.

The *Fungi* confounded with *Lichens* belong chiefly to the following genera:—

Fam. ASCOMYCETES.

Order 1. SPHÆRIACEI.

*1. Sphæria, *Hall.*
2. Dothidea, *Fr.*
3. Dichæna, *Fr.*
4. Nectria, *Fr.*

Order 2. HELVELLACEI.

*1. Patellaria, *Fr.*
2. Peziza, *Link,* including the subgenus Patellea.
3. Stictis, *Pers.*

Order 3. PHACIDIACEI.

1. Phacidium, *Fr.*†
2. Hysterium, *Tode.*

Of these by far the most important are *Patellaria* and *Sphæria*.

The *Lichens* mistaken for *Fungi* belong mostly to the following genera:—

Order 1. VERRUCARIACEÆ.

1. Verrucaria, *Pers.*
2. Microthelia, *Kbr.*
3. Endococcus, *Nyl.*
4. Thelenella, *Nyl.*
5. Thelidium, *Massal.*
6. Tichothecium, *Fw.*
7. Limboria, *Ach.*

* *Chrysothrix*, Montagne [" Diagnoses Phycologieæ," Ann. des Sc. Nat., 3rd ser. Botany, 1852, p. 317] is a new genus of *Collemaceæ*. Stizenberger (p. 141) places it in the *Cænogonieæ*; Massalongo (Att. Ist. Venet. vol. v. ser. 3) in the *Parmeliaceæ*; P. Nylander among the *Arthoniæ*. Montagne's genus *Cilicia* is partly, at least, a synonym of *Chrysothrix*.

† Compare Eugène Coemans, 'Notice sur quelques Cryptogames Critiques de la Flore Belge,' p. 7: Brussels, 1858.

Order 2. Lecideaceæ.

1. Lecidea, *Ach.*
2. Abrothallus, *De Not.*
3. Celidium, *Tul.*
4. Scutula, *Tul.*
5. Odontotrema, *Nyl.*

Order 3. Graphideaceæ.

1. Arthonia, *Ach.*
2. Coniangium, *Fr.*
3. Spiloma, *Ach.*

Order 4. Lecanoreaceæ.

1. Lecanora, *Ach.*

It thus appears that the alliance is closest and the confusion greatest between the *Verrucariaceæ* among *Lichens*, and *Sphæriacei* among *Fungi*; and next between *Lecideaceæ* and *Helvellacei.*

A distinction between the *Verrucariæ* and *Sphæriæ* has been sought for in the supposed fact that the former, when corticulous, affect exclusively *living* tree-barks; while the majority (in this country at least) are probably saxicolous.

From the circumstance that the same organism has been frequently described and named now as a *Fungus*, now as a *Lichen*, and transferred, under ever-changing designations, from genus to genus of either or both of these orders, it happens that, in many of them at least, their synonymy is most perplexing and abundant—so much so indeed that I think it would be satisfactory to altogether ignore it, and to have the puzzling plants in question re-examined and re-named, according to current views, *by a council of competent fungologists and lichenologists.* To do otherwise, to add to the present superabundance and entanglement of names, is merely to "make confusion worse confounded."

In order that I may the more clearly set forth the nature of the difficulties to which I am here endeavouring to draw the attention of cryptogamic botanists, in regard to the diagnostic distinction of, or line of separation between, the lower Lichens and Fungi, I subjoin a few illustrative cases, as types of the group of dubious organisms which they represent.

By the apothecia alone it is impossible to distinguish the genus *Patellaria* (Fungi) from certain groups, at least, of the genus *Lecidea* (Lichens). In both the apothecium is roundish, black, and patellæform ("patella," a platter), discoid, with a margin of similar colour and character to the disk. The true *Lecideæ*, indeed, the type of the genus *Lecidea*, are characterized by their Patellarioid apothecia*, constituting the Lichen-genus *Patellaria*,

* Nyl. Lich. Scand. p. 214.

Pers. *Patellaria* is a section of the *Parmeliaceæ* (Lichens) [in Fries, Lichen. Europ. Reform. 1831, p. 3]. Various forms of *Lecideæ* and *Lecanoræ* (Lichens) have been confounded with forms of the genus *Patellaria*, Fr. (Fungi) : e. g., *Lecidea parasema*, Ach. var. *saprophila*, Ach. [with *P. atrata*, Fr.]; *Lecanora varia*, Ach., var. *conizea*, Ach.; and *Lecanora ferruginea*, Huds., var. *festiva*, Ach. In these and such cases the main or only distinction between the Lichen and the Fungus appears to consist in the different reaction of the hymenium with iodine in the two cases, being *blue* in the Lichen and *yellow* in the Fungus.

Berkeley, in his 'Outlines of British Fungology'*, includes three genera among Fungi, which modern Lichenologists class among Lichens, viz. :—

1. *Sphinctrina* †; and its species *S. turbinata*, Pers., which is athalline and a parasite on the thallus of various *Pertusariæ*. The *Caliciaceæ* [to which *Sphinctrina* belongs], and especially perhaps the genus *Coniocybe*, have a general resemblance to certain stipitate, delicate, minute Fungi.
2. *Xylographa* ‡, and its species *X. parallela*, Fr., where there is scarcely any thallus and the reaction with iodine is *blue*, becoming wine-red.
3. *Agyrium* §, and its species *A. rufum*, Pers., which resembles the former genus and species as to its thallus and reaction with iodine.

On the other hand he points out [in his 'Cryptogamic Botany,' p. 374] that the exotic *Hypochni*, Montagne's genus *Byssocaulon*, *Thelephora pedicellata*, Schweinitz, and other hitherto supposed *Fungi* are really referable to *Lichens*. Nylander [L. Scand. 20] also arranges *Byssocaulon* among Lichens [next to *Cœnogonium*, (*Lecideæ*)]. *Gassicurtia* is regarded as a *Lichen* by Berkeley [Crypt. Bot. 378 ||], and as a *Fungus* by Nylander [Prodr. 91]. *Asterina Babingtonii*, Berk. [Ord. *Phacidiacei* (*Fungi*)] is the *Strigula* [*Lichen*] of subsequent authors. Berkeley remarks that he is *constantly* receiving degenerate states of Lichens as supposed

* Of date 1860, pp. 373 and 375.

† Mudd, 'Manual,' p. 255; Nylander, Lich. Scand. p. 37; Prodrom. p. 33.

‡ Nyl. Prodrom. p. 147; Lich. Scand. p. 249; classed as a subgenus of *Stictis* by Berkeley, Brit. Fung. p. 375.

§ Nyl. Prodr. p. 148; Lich. Scand. p. 250. Compare Coemans, 'Notice sur quelques Cryptogames de la Flore Belge,' pp. 15–19.

|| [The genus mentioned by Mr. Berkeley at p. 378 is *Gassicourtia*, which he subsequently (p. 415) speaks of as an anamorphosis of some lichen. *Gassicurtia* is spoken of at p. 415 as an obscure genus.—SEC. L. S.]

Fungi,—an experience which doubtless could be confirmed by Currey, Cooke, and other British Fungologists.

Sphæria scoriadea, Fr., Currey suggests may be *Verrucaria conferta*, Tayl. (a Lichen) *; and *S. micraspis*, Berk., a *Pertusaria* (also a Lichen) †. The British *S. mastoidea*, Fr., which grows on dead ash-twigs, &c. [Berkeley Brit. Fungol. 396], is not unfrequently associated with and mistaken for some of the larger corticolous *Verrucariæ* ‡ [e. g. *V. gemmata*, Ach., in a specimen from Killarney in the Herbarium of the British Museum]; while *Sphæria betulina* is associated and confounded with *Verrucaria albissima*, Ach. in Heppe's Exs. 460.

Celidium stictarum, Tul. (which constitutes the genera *Delisea* and *Plectocarpon*, Fée §), a parasite affecting the apothecia, cephalodia, or thallus of various species of *Sticta*, is regarded as a Lichen by the eminent Fungologist Tulasne ‖, while by his fellow townsman Nylander, an equally eminent Lichenologist, it is considered a Fungus ¶.

Scutula Wallrothii, Tul., which gives a reaction with iodine varying from blue to wine-red, is considered a Lichen by Tulasne ** and Nylander (the latter regarding it as a variety of *Lecidea anomala*, Fr. ††), while by Wallroth himself it was described as a *Peziza* (*P. miliaris*). Anzi classes the genera *Scutula* Tul., *Celidium* Tul., *Abrothallus* Not., *Tribothecium* Mass., *Isomera* Mass., and *Krempelhuberia* Mass. as "genera *inter* Lichenes et Fungos incedentia;" but he places *Microthelia* among the *Verrucariæ* ‡‡.

The parasite on the apothecia of *Lecidea microspora*, Nyl., once described by him as *Psora aporea*, a Lichen, he subsequently refers to as a Fungus, under the name of *Hymenobia insidiosa* §§. *Bæomyces microcephalus*, Tayl., Fl. Hib., is, according to Mudd ‖‖,

* "Synopsis of the Fructification of the compound *Sphæriæ* of the Hookerian Herbarium," Trans. Linn. Soc. vol. xxii. p. 283. † *Ibid.* p. 321.

‡ For fuller remarks on the *Sphæriæ* in their relation to the *Verrucariæ*, vide Mem. Spermog. pp. 105, 107, 112, and 299.

§ Nyl. Synopsis, p. 352.

‖ "Mém. pour servir à l'histoire organograqhique et physiologique des Lichens," Ann. des Sc. Nat. (Botany), 3rd ser. vol. xvii. (1852) p. 120.

¶ Nyl. Lich. Scand. p. 96. ** Mém. Lich. p. 119.

†† Lich. Scand. p. 203.

‡‡ Catalogus Lichenum quos in provincia Sondriensi et circa Novum-Comum collegit Martin Anzi, Introductio, p. xvi: 1860.

§§ Prodromus Lichenographiæ Galliæ et Algeriæ, p. 125.

‖‖ Manual, p. 64.

a Fungus. The old Lichen-genus *Spiloma*, like *Gassicurtia*, consists mostly of minute Fungi, often with black spores, which germinate readily. Some of them are parasites analogous to the *Uredineæ* of Phænogams, and are referred by Nylander [Syn. 15, Prodr. 91] to his genus *Spilomium* [*Uredineæ* (*Fungi*)]. The old Lichen-genus *Lepraria* is at least partly referable to *Byssus*, L., an equally spurious genus belonging partly to the *Fungi* and partly to the *Algæ*. Some species of *Endocarpon* also prove to be *Fungi*: e.g. *E. eburneum*, D.C., which is an Endocarpicolous *Sphæria* [Nyl. Classif. Nouv. 197].

The genus *Endococcus*, Nyl. [*Tichothecium*, Fw.]*, is athalline, the apothecia (and, where they occur, the spermogones) being parasitic on the thallus or apothecia of various crustaceous Lichens. It resembles, on the one hand, *Verrucaria* (Lichens), and, on the other, *Sphæria* (Fungi); and the only apparent reason for classing it with the former instead of the latter is, that its hymenial gelatine gives a red or violet colour with iodine.

The genus *Microthelia*, Körb. [*Tichothecium*, Fw.], [Mudd, Manual, 306] is obviously a heterogeneous and provisional one, demanding revision. Some of its species have a thallus; others are devoid thereof, occurring as parasites on the thallus of higher lichens; some occur both thalline and athalline; some are 8-spored, others polyspored. One, at least, is a *true Sphæria*, according to Currey, viz. *S. ventosaria*, mihi (collected in 1858), described as *Microthelia ventosicola* by Mudd†. Others, if not all, of its species would be more properly, I suspect, regarded as Fungi.

Resembling for the most part the genera *Microthelia* and *Endococcus*, are the following genera:—

1. *Thelidium*, Massal. ‡, the athalline species whereof are parasitic on the thallus of higher lichens.
2. *Thelenella*, Nyl. §., where the hymenial gelatine is *un*affected by iodine.
3. *Limboria*, Nyl.||, where the same gelatine, under the same reagent, becomes blue, or wine-red.

The genus *Odontotrema*, Nyl., is referred by Nylander, in his latest work ¶, to the Lichens, though he admits it belongs, perhaps, more properly to the Fungi. Here the thallus can scarcely

* Lich. Scand. p. 283; Pyrenocarp. p. 63.

† Manual, p. 307.

‡ Mudd, *ibid.* p. 298.

§ Pyrenocarp. p. 62.

|| Lich. Scand. p. 283.

¶ Lich. Scand. p. 249.

be said to exist, and gonidia are absent; but the hymenial gelatine gives a wine-red with iodine.

Abrothallus Smithii, Tul., described by the fungologist Tulasne as a Lichen *, is regarded by the lichenologist Nylander as a Fungus †. I have elsewhere ‡ shown that this species differs from another, which very generally accompanies it as a parasite on *Parmelia saxatilis*, Ach. (*A. oxysporus*, Tul.), in the absence of a blue reaction with iodine; the absence of spermogones and the presence of pycnides; and the possession of brown, 1-septate spores, resembling (save as to size) those of *Arthonia melaspermella*. But, notwithstanding these marked differences, which, after all, are not greater than those characterizing certain species of such genera as *Arthonia* and *Lecidea*, it seems unnatural to separate into two different orders of Cryptogams plants otherwise possessed of similar characters, and which affect the same lichen as parasites, producing or occupying the same anamorphoses, or deformities, of its thallus. I have been strengthened in this conviction by the circumstance that in New Zealand I found an intermediate form or species of *Abrothallus*, to which I have given the name *Abrothallus Curreyi*, which resembles *A. Smithii*, *quoad* its apothecia, and *A. oxysporus*, *quoad* its reaction with iodine, and its spores (the spores sometimes, however, in *A. Curreyi* showing a tendency to division into two). In the latter species I have not succeeded in detecting either spermogones or pycnides; but my specimen is unique, and either or both may confidently be looked for in any suite of specimens. On a sterile specimen of *Parmelia lævigata*, Ach., var. *sinuosa*, Lin., in the Hookerian Herbarium [from Wollanaboon, Sikkim, Himalayas, reg. temp. 10,000 ft., Dr. Hooker], I found a form of *A. Curreyi* affecting bullosities of its thallus, similar to those produced by *A. sysporus* in *Platysma glaucum*, a form characterized by crescent-shaped, colourless, bilocular [sometimes polari-bilocular or physcoid] spores.

Some of the plants described by the older lichenologists as *Lecidea dryina* appear to be Fungi. According to Nylander, *L. dryina*, Flk., is one (*Schizoxylon dryinum*, Flk. §). Here the hyme-

* Mém. Lich. p. 113.

† Lich. Scand. p. 99; Prodrom. p. 55 [sub nom. *Habrothallus parasiticus*, and including *A. Welwitschii*, Tul., and *A. microspermus*, Tul.].

‡ "Monograph of the genus *Abrothallus*," Quart. Journ. of Microscopical Science, January 1837, vol. v. plates 4, 5.

§ Lich. Scand. p. 249.

nium is either *un*affected by iodine, or it becomes exceptionally very slightly blue. Its ally, *Lecidea patellarioides*, Nyl.*, may also by Fungologists be regarded as a Fungus. The thallus is absent, or nearly so; the apothecia have the characters of those of the genus *Patellaria*, Fr. (Fungi), as well as of the Patellarioid *Lecideæ* and *Arthoniæ*; the hymenium is *un*affected by iodine, or becomes obscurely blue or reddish. The acicular spores distinguish these two species from (but otherwise there is considerable resemblance to) *Arthonia melaspermella*.

Lecidea resinæ, Fr., one of the most beautiful of our native Lecideæ, though classed by Nylander, in his latest work, as a Lichen†, he suggests may be more properly regarded as a Fungus. Fries, the eminent Scandinavian Fungologist, described it as a *Peziza* (Fungus). It is the *Peziza myriospora* of Hepp. Exs. 332. In this plant there is sometimes, apparently, a thallus, sometimes none; and where it exists it seems doubtful whether it belongs to the Lecidea; the polysporous thecæ, and the extremely minute globose spores are at least exceptional and peculiar in the Lichen-genus *Lecideæ*. The hymenial gelatine gives an intense *blue* colour with iodine; and there is this further feature of interest, that the organism hitherto known as *Sphæria resinæ*, Fr., constitutes the spermogones of the *Lecideæ*. In the Hookerian Herbarium I have found *Peziza Neesii*, Flot., confounded with *Lecidea anomala*, Fr., among which it grows on the same bark in some foreign specimens. The black perithecia of the *Fungus* are seen irregularly bursting through the bark on which the apothecia of the *Lichen* are simply adnate or sessile.

A still more beautiful flesh-coloured Lecidea, *L. lutea*, Sch., Nylander also suggests may find its proper place among the Fungi rather than among the Lichens, though he still classes it with the latter ‡. It gives a wine-red with iodine, but contains *no gonidia*. He appears disposed to regard it as a *Stictis*, allied to *S. pallida*, Pers. §, whose hymenial gelatine gives also a wine-red colour with iodine, but which *contains*, according to Nylander, *gonidia* ‖. Nevertheless this beautiful little plant, *Lecidea lutea*, has externally quite as much the aspect of a Lichen as *Lecidea pineti*, Ach., or members of the *Gyalecta* section of the *Lecideæ*.

The distinguishing characteristics by which fungologists and lichenologists at present profess to be guided in the nomenclature

* Lich. Scand. p. 211. † *Ibid.* p. 213. ‡ *Ibid.* p. 192.

§ *Lecidea pallida*, Nyl. Prodrom. p. 102. ‖ Prodrom. p. 103.

and classification of fungi having a lichenoid, and lichens having a fungoid aspect (but all of which supposed characteristics appear to me to be utterly fallacious when applied to certain individual cases) are mainly the following:—

1. *Presence of gonidia* in the thallus. But a large group of Lichens is *a*thalline—that, to wit, in which the apothecia (with or without spermogones or pycnides) constitute the plant, and are parasitic on the apothecia or thallus of other, generally higher, Lichens. In such cases there can be no gonidia. It is necessary, however, to distinguish the *apparent* from the *real* absence of a thallus. Though apparently absent, the thallus of a Lichen may really exist in the form of a few scattered gonidia, to be discovered only by careful microscopic examination of the superficial fibres of the wood, or particles of the stone, whereon the apothecia occur. This is, perhaps, one of the most rudimentary or simple forms of thallus. It may also, though apparently absent, be hypophlœode, consisting of a few gonidia associated with a meagre mycelioid (medullary) tissue, developed in, or under, the tree-bark on which the apothecia are seated. The thallus is either absent or evanescent, or hypophlœode or rudimentary, [for instance] in a large proportion of the species of the genera *Verrucaria*, *Arthonia*, *Opegrapha*, *Graphis*, and *Lecidea*. And, on the other hand, Nylander, who of all living lichenologists has the widest acquaintance with the Lichens of every part of the world, points out that certain other Lichens have no gonidia (*Odontotrema*, *Myriangium* *, *Lecidea lutea*), though this is, perhaps, a strong argument for transferring them to the Fungi, in which case their absence would form no exception to the rule; while some plants, which he considers Fungi, possess gonidia (*Stictis pallida*), in which case the exception might also be abolished by retaining the plant as a Lichen (*Lecidea*). Currey, however, remarks [letter Sept. 1865], "*Gonidia are absolutely unknown in Fungi*; so that their existence would fix the true nature of the great mass of the Lichens, unless I am mistaken in my notion of their constancy" †.

* *M. Duriæi*, Mnt. & Berk., Nyl. Synopsis, p. 10. But *Myriangium* is so exceptional in its whole structure, that, if it does not properly belong to the *Algæ*, it would find an appropriate place in my provisional group of *Algo-lichenes*.

† [Bodies supposed to be of the nature of gonidia have, however, been noticed by Bail (Flora, 1857), Zabel (Mélanges biolog. St. Pétersbourg, t. iii.), and by Berkeley (Introd. to Crypt. Bot. under *Emericella*).—SEC. L. S.]

2. *Presence of* octahedral crystals of *oxalate of lime* in the thallus. Nylander* thinks that this affords an additional test; and it may constitute a corroborative feature in the *crustaceous lichens*, in whose thallus this salt occurs in considerable quantity, e. g. *Urceolaria* and *Variolaria*. But, so far as my experience extends, its presence is confined to the crustaceous thallus; and the test is thus obviously impotent in the large class of Lichens which are *a*thalline and parasitic.

3. *Presence of starch-grains* (*Lichenine*) in the thallus. Similar remarks apply here; for though starch is to be found in considerable quantity in the thallus of several of the higher Lichens (e. g. *Cetraria*, *Ramalina*, and *Cladonia*), it cannot exist in *a*thalline forms.

4. *Blue reaction of the hymenial gelatine with iodine.* What is called, for convenience' sake, "hymenial gelatine," is really a gummose amylaceous substance, known to chemists as *lichenine*. It envelopes and lines, or occupies, the cavity of the *thecæ*; and it is chiefly in and on these, especially at their tips, gradually diminishing in intensity downwards, that the beautiful blue reaction with solutions of iodine, characteristic of starch, is observable. This lichenine, in the form of a colourless hyaline jelly, likewise bathes the bases of the thecæ and paraphyses, and is sometimes intermixed with the whole tissues of the hymenium. The blue reaction is sometimes, therefore, observable principally at the tips of the paraphyses, or at their bases, or throughout their whole extent; and it may be exhibited in the hymenial lichenine when there is no discoloration of the thecæ or paraphyses †. The reaction of the constituents of the hymenium with iodine is, however, very variable in Lichens; the colour developed may be any shade [to the faintest] of Prussian blue, violet, or wine-red; and, moreover, there may be *no* development or *exhibition of colour at all*; or it may be yellow; or it may be that belonging to the test or reagent itself. In certain groups or species of the *Verrucariæ*, for instance, the hymenium is *un*affected by iodine; in others, though exceptionally, a blue, yellow, violet, or wine-red colour is developed, though generally very faintly. In *V. dubiella*, Nyl., and *V. endococcoidea*, Nyl., two recent additions to the Scotch Lichen-flora, the hymenial gelatine is *wine-red* with iodine; while,

* Lich. Scand. p. 14.

† In a very few exceptional cases, *e. g.* in *Graphis* and *Thelotrema*, sometimes, the lichenine enveloping the *spores* is the only seat of colorific reaction. I have observed such a coloration [where the *thecæ* were equally affected] in the spores of *Parmelia megaleia*, Nyl., from the Sikkim-Himalayas.

in the latter species also, the *spores* are pale *blue*. In the genus *Graphis* the hymenial gelatine is *un*affected, or yellowish; though a bluish coloration is sometimes visible on the spores.

While, on the one hand, the reaction supposed to be characteristic of Lichens is absent in certain indubitable Lichens, it is also present in certain indubitable Fungi. For instance, the tips of the *thecæ* in *Sphæria pedunculata*, Dicks., and *S. Desmazierii*, Berk., and various other *Sphæriæ*, as well as in *Peziza vesicularis*; and the gelatine of the receptacles in *Septoria ulmi*, Grev., strike a more or less intense and beautiful *blue* with iodine *.

In a recent note in the 'Flora' [Oct. 10, 1865], Nylander points out that the hymenial gelatine becomes *blue* under iodine in several species of *Peziza* [e. g. *P. cochleata*, Huds., and *P. violacea*, Pers.], the apices of the thecæ, as in Lichens, being the seat of the greatest depth of tint. In many other species [including *P. porina* Pers., *P. plumbea* Fr., *P. juncigena* Nyl., *P. undella* Fr., *P. cerea* Sow., *P. repanda* Wahl.] the thecæ, or their apices only, as is also the case in many Lichens, assumed the blue tint in question. He points out, further, that the same fungus may give a different reaction with iodine according as it is freshly gathered, or an old herbarium specimen. He found that the hymenial gelatine of *Peziza Polytrichii*, Schum., collected in Helsingfors, Finland, gave an intense blue reaction with iodine when fresh; whereas the *same specimen*, when two years old, in an herbarium, exhibited no coloration at all. Nylander and Leighton appear to regard this different result of *age* as *pro tanto* a distinguishing feature between Lichens and Fungi, the same reaction occurring, says Leighton [" Notulæ Lichenologicæ," no. 1, " On the Reaction of Iodine in Lichens and Fungi," Ann. Nat. Hist., Jan. 1866, p. 58], in Lichens whether they are old or recently gathered. I can only say that such a statement is entirely opposed to my own experience, which led me to regard *this* criterion as equally fallacious with the others that have from time to time been established for the differential diagnosis of Lichens and Fungi †.

* Tulasne, Ann. des Sc. Nat. sér. 4. t. vi. p. 318; Nyl. Syn. p. 4.

† [The most remarkable case of coloration by iodine in Fungi is that of *Amylocarpus encephaloides*, Curr., described in the Proceedings of the Royal Society for January 28, 1858. From a reexamination of this plant I can quite confirm Dr. Lindsay's opinion that the criterion of *age* is fallacious. *Amylocarpus encephaloides* has been in my herbarium for nine years; and although the sporidia are not affected by iodine as they were at first, the viscid matter surrounding them assumes the same intense purple colour which it did when the plant was fresh.—SEC. L. S.]

5. *Presence of distinct Paraphyses with clavate or knob-like, frequently coloured, heads.* Though these are characteristic of the higher or typical Lichens, they do not occur, at least in this form, in the lower. In them the paraphyses are visible either as a confused mass of very delicate, filiform, hyaline tubes, or as a mere striated jelly; or they are altogether absent. In certain genera, e. g. *Verrucaria*, these indistinct or obscure forms occur; or the paraphyses are absent, as they are also in *Myriangium* and *Endocarpon*.

6. *Presence of Spermogones.* Spermogones and pycnides, however, even in the same species, are common to certain Fungi with certain Lichens. They occur, for instance, in *Sphæria epicymatia*, Wallr. (Fungi), which, moreover, is a parasite occurring on the apothecia of a Lichen, *Lecanora subfusca*, Ach., var. *albella*, Nyl.*, in the genus *Strigula* (Lichens), and in certain species of *Arthonia* and *Opegrapha* †. In some cases, only spermogones or pycnides occur with the sporiferous apothecia or perithecia, as in certain species of *Abrothallus* ‡, *Peltigera*, *Lichina*; at other times the spermogones or pycnides occur alone, or on a separate thallus from the said apothecia or perithecia; in some of which cases, at least, the plants are truly *diœcious*. We are yet, however, in comparative ignorance of the proper line of separation (if such a line actually exists) between *pycnides* and *spermogones*, and of the rôles which they respectively play in the function of reproduction in either Lichens or Fungi.

All which foregoing considerations lead me to the conclusion that—

1. *Arthonia melaspermella*, Nyl., has an equal claim to be considered, on the one hand, a *Lecidea* (Lichen), and a *Patellaria* (Fungus).

2. Certain dubious Lichens with a Fungoid facies, and Fungi with a Lichenoid aspect, deserve and require re-examination and re-classification and nomenclature *by a joint committee of fungologists and lichenologists.*

* Prodrom. p. 85.

† Among Fungi [*e.g.* the *Uredineæ*, genera *Rœstelia*, *Æcidium*, *Peridermium*, and others] the occurrence of spermogones has been well pointed out by Unger, De Bary, and Tulasne (Cooke, 'Microscopic Fungi,' 1865, pp. 22, 31); while the presence of pycnides, and the part they possibly play in the multiform fructification of Fungi, is adverted to by Berkeley in his 'Introduction to Cryptogamic Botany,' 1857, p. 331, and 'Brit. Fungology,' p. 50.

‡ "Monograph of the genus *Abrothallus*," and 'Memoir on the Spermogones and Pycnides of Lichens,' *ol. cit.*

3. Until which time it is convenient to assemble them in a provisional and transitional order of *Fungo-lichenes*.

EXPLANATION OF PLATE VI.

Figs. 1 to 6. *Arthonia melaspermella*, Nyl.

1. Nat. size.
2. Greatly magnified.
   a, b. Apothecia.
   c. Pycnides.
3. Diagrammic section through
   a, b. Apothecia.
   c. Pycnides.
4. Section of Hymenium (Apothecium), mag. 425.
   a. Thecæ. *b, c.* Paraphyses.
   d. Hypothecial tissue.
5. Spores, mag. 425.
6. Section of a Pycnidium.
   a. Stylospores.
   b. Sterigmata.

Fig. 7. *Arthonia pruinosa*, Ach., var. *spilomatica*, Fw.

a, b, Sterigmata } of a Pycnidium.
c. Stylospores }

Fig. 8. *Arthonia pruinosa*, Ach.

a. Sterigmata } of a Spermogonium.
b. Spermatia }

Figs. 9, 10. *Arthonia astroidea*, Ach., var. *Swartziana*, Ach.

a, b. Sterigmata } of a Pycnidium.
c. Stylospores }

Fig. 11. *Arthonia astroidea*, Ach.

a. Perithecium }
b. Sterigmata } of a Spermogonium.
c. Spermatia }

Observations on the Origin and the Geographical Distribution of the Gum Copal in Angola, West Tropical Africa. By Fred. Welwitsch, M.D., F.L.S.

[Read Feb. 15, 1866.]

At the Meeting of the Linnean Society on the 21st December last year, a paper on Amber was read, and reference was made to the various kinds of Gum Copal. I much regret that illness prevented my being present at that Meeting, but being desirous to contribute somewhat to the knowledge of this valuable resin, I take the liberty of offering the Linnean Society some remarks on this subject, mostly taken from notes and observations made during my travels in West Tropical Africa. If my observations are not conclusive, especially with regard to the species of trees which at present furnish, or may have formerly furnished, this resin, I hope at least to be able to show that nearly all the opinions heretofore published on this subject are more or less erroneous; and my remarks may therefore induce future researches in a different direction, which may lead to a more satisfactory result.

I shall commence my remarks by stating the most important facts as to the nature and appearance of Copal, and its geographical distribution in Angola; next I shall speak of its varieties and its mercantile importance; and finally say a few words on the supposed origin of this valuable resin, stating the observations of other authors, and the views formed by myself during my residence in Tropical Africa.

I. *On the occurrence, appearance, the geographical distribution, and the manner of gathering Gum Copal in Angola.*—Gum Copal, which is called by the Bunda negroes *Ocote Cocoto*, or *Mucocoto* (and which is found in the hilly or mountainous districts all along the coast of Angola, including the districts of Congo and Benguella, lately united with that province, and also in some places even further east), is brought by the natives to the different market-places on the coast of Angola near the Atlantic Ocean, amongst which the most important are Ambriz, Loando, Novo Rodondo, Benguella, and Mossamedes. The larger quantities of this resin are mostly found in the sandy soil, which is studded with thorny bushes of *Acacia*, *Dichrostachis*, and aphyllous *Euphorbiæ*, or sometimes covered here and there with forests of *Diospyros*, Leguminosæ, Cæsalpineæ, Combretaceæ, and Celastrineæ, and which is situated in the hilly region extending, with little interruption, across 700

geographical miles southwards, at the foot of the first terrace from the river Zaire to Cunene. The hilly tract itself, which in its greater portion is rocky or stony, is often intercepted by extensive sandy plains, rising slightly, and extending inland to the foot of the first chain of mountains, upon which the above-named trees mostly appear as bushes or low dwarfy shrubs; and among them are also observed the *Mærua Angolensis* and other Capparideæ, several Loganiaceæ and Acanthaceæ, bushes of a species of *Balanites*, dwarf specimens of *Hyphæne* and a *Bauhinia*. Almost the whole of this region, which we may call the inner littoral region, bears a dull desolate aspect; and it is only in slopes and in deep ravines, where a stratum of red clay may be seen, that a varied and luxuriant vegetation occurs, which gradually increases towards the small lakes and rivulets, and which, on the banks of the large rivers, manifests all the richness and variety peculiar to equatorial countries. The higher slopes of the hills next to the mountains are covered more or less with extensive forests, which, according to different latitudes, consist of Diospyreæ and Combretaceæ, or sometimes of Sterculiæ and Cynomatiæ, and in the southern districts of Mossamedes, of the *Copaifera Mopane*, lately described by Mr. Bentham in the last published part of the Linnean Transactions. In the hills and undulations of gravelly soil, between the rivers Dande and Bengo, in the north of Loando, and there only, I met with an area of more than ten miles nearly exclusively covered with Hyphæne Palms, which are probably identical with the *Hyphæne cucifera*, Pers. After several years of observation in various places of this region, I conclude that these palm-forests covered in past ages a great portion of the coast districts of Angola, where, however, at present they only appear as dwarf bushes without stems, and never blossom.

This gradual falling off in the vegetation is observable in a similar manner in several other dwarf shrubs belonging to the Rubiaceæ, Jasmineæ, Combretaceæ, and especially in the *Mærua Angolensis*, which is the one most frequently found, but which, during my numerous wanderings, I only met with three or four times developed as full-grown trees. The only kind of tree which seems to brave this general dwindling away of vegetation is the well-known *Adansonia*, which is seen in full splendour throughout the district, either singly or in groups. The rains which fall in this region are almost without exception passing thunder-storms, discharging within a few hours immense quantities of water,

which flows immediately into rivers or the sea, thereby doing little good to the thirsty sandy soil. Still these rains, which produce here and there small rivulets, furrowing the soil in every direction, enable even the sandy plains to bring forth for a few months during the year a lovely green, chiefly of Gramineæ, Cyperaceæ, Leguminosæ, and Compositæ. Immediately after these heavy rains, the temperature rises to so high a degree that, within a few days, a great number of delicate plants fade away; and even shrubby plants suffer sometimes so much that they do not blossom, or do not bring forth ripe fruit, during several years. This may be one of the many reasons which have caused the gradual dwindling away, and I might say the dwarfing, of the vegetation in this region. The breadth of this littoral region, from the shores of the Atlantic Ocean to the foot of the first high terrace, varies very much, according to the different curves of this last-named mountain-ridge: sometimes (for instance, near Libongo and the Dande) it only measures a few miles; whilst at other places, near the Bengo River, it extends inward fifty or more geographical miles. In many places where the mountain-ridge of the terrace is intercepted by wide clefts, or by broad valley slopes, this littoral region is extended far into the mountain-terrace itself, forming in the middle of the primeval forests larger or smaller sand oases, covered with low shrubs or single dwarf trees. On the other hand, the luxuriant and varied vegetation of the primeval forests reach sometimes from the terrace close down to the Atlantic coast district, especially along the narrow vales abutting on the sea, and still more so those extending along the banks of the larger rivers like the Zaire, the Loge, Dande, Bengo, Cuanza, and the Cotumbella. In such places the traveller suddenly finds himself, to his great surprise, transported within a few paces from a barren desert into a landscape abounding in the richest crops; among which are seen the bright green of the Oil Palm, and the majestic foliage of the graceful Raphias, whilst the towering crowns of the Bombax, several varieties of Ficus, and the beautiful slender Cocoa Palm, sometimes alone and sometimes in small groups, spread high above the exuberant mass of vegetation.

From the fact of the coast district penetrating here and there with its vegetation into the high mountain-terrace, it follows that its limits towards the interior of the continent do not form a clearly defined curve, but rather a sharp zigzag line; which accounts for Gum Copal being sometimes found in places far

inland. Trusting to the reports of others, and to my own experience, I believe that I may assert that the geographical distribution of the *Adansonia digitata* circumscribes in West Tropical Africa, and particularly in Angola, the limits within which Gum Copal is found at present or will be found in future. In those districts of Angola, rising more than 3500 feet above the level of the sea, and in which the *Adansonia* is rarely met with, and generally not at all, it appears that no Copal is found; nay, even at the height of 2500 feet it is seldom found, and only in very few places.

Of all the districts constituting the province of Angola, the lands in the interior belonging to the government of Benguella yield the most. They extend south of the Cuanza river, along the western ridge of the mountain-terrace of Amboin, Selles, and Mucobale. The quantities of this resin exported from Benguella amounted from 1850 to 1860 to 30,000 arrobas—*i.e.* 1,600,000 lb. per annum*.

I have been circumstantial in defining the region where the Gum Copal of Angola is mostly found, and in giving a general description of its vegetation; for it is obvious that it must be in this region where we must search for and find the trees which furnish the Gum Copal, and which, according to most of the published reports, are growing there even now in large numbers. This is a question to which I shall return after having given some details with regard to the occurrence and the way and manner of gathering this resin. It is a general and widely spread opinion that the Gum Copal in Angola is gathered from trees; but this, according to my own observation, is obviously erroneous; for the Gum Copal is either dug out of the loose strata of sand, marl, or clay, or else it is found in isolated pieces washed out and brought to the surface of the soil by heavy rainfalls, earth-falls, or gales; and such pieces, where found, induce the negroes to dig for larger quantities in the adjacent spots. This digging after larger quantities is, as may be supposed, often very successful; but sometimes it is less satisfactory, or totally without result, just in the same manner as with people digging for gold. At times numerous larger and smaller pieces of Copal are found close to the surface of the sand, or within the depth of a few feet, whilst in other places, after digging to the depth of five to eight or even ten or more feet, only single pieces, or sometimes none at all, are brought to light. As soon as a negro has discovered

* T. A. de Souza, in Alman. de Cambr. 1858, page 234.

in any spot one or more pieces of Copal, he hastens to his relations and to his commercial friends, telling them of his fortunate treasure-trove, showing what he has found, and concludes with them a kind of treaty of partnership, whereby he becomes entitled to the larger share in the probable gains. The members of this partnership then provide themselves with digging-implements, including large sacks, mostly made of the bark of the *Adansonia* or *Raphia* leaves, and they then proceed to the indicated spot to commence researches. As is natural, such a spot and its neighbourhood are not left until the diggers have convinced themselves that they have completely exhausted the district, or that no more Gum Copal is to be found beyond the first indicating pieces. In the latter case it is supposed that the first pieces met with were washed down from afar, and further researches are then made accordingly.

On these journeys the Copal-gatherers often separate from each other for several days, during which time they pass the nights round a fire in caverns, or in places hidden by thickets, so as to recommence their work early every morning. Searching after Gum Copal is frequently combined with the gathering of Urzella (being different varieties of *Roccella fuciformis* growing on trees), which, however, only takes place on that part of the littoral region which is situated near the coast, as this lichen does not grow far inland; even on the border of the first mountain-terrace it is only seen here and there in single specimens, or it entirely disappears. On these occasions the Gum-Copal seekers also gather several other gums, including the Gum Arabic, which is found on the Acacias in these countries. This accounts for the fact that amongst the Gum Copal which is brought to market a few resins and pieces of Gum Arabic are also found.

If after prolonged researches in the same district no more Gum Copal is found, the diggers leave that place; the secured resin is cleaned by washing, and packed in sacks, to be ready for sale in the markets on the coast. Different varieties of Gum Copal of unequal value being often obtained on the same spot, the resin, when brought to market, has to be sorted before being sold. It is classified mostly according to its colour; and the price is determined by weight. The deep-coloured quality is generally worth double the price of the lighter sort.

This brings us to—

II. *Considerations on the different varieties of the Gum Copal*

of Angola, and their mercantile importance.—The shape in which Gum Copal is found is very various: it often has the form of an egg, a ball, or a drop; at other times it looks like a flat pressed cake; and it is also met with in sharp-canted pieces. The pieces of Gum Copal vary as much in size as in shape: they are rarely larger than a hen's egg, and there are many much smaller; others (which, however, seldom occur) are as big as a man's fist, or even a child's head, weighing three to four pounds and more. All the pieces of Gum Copal of different shape and size have one common characteristic, viz. that on their surface they are covered with a thinner or thicker close-sticking, whitish, nearly chalky crust, which exhibits on many pieces veins or network, whilst in most instances it covers the surface like an earthy powdery coat. The surface of fresh-broken pieces appears conchoidal, with finely radiating lines in each conchoidal impression. The lustre is glossy; the mass is hard and transparent to a certain depth, and where scratched with a knife or needle it leaves a white-powdered stroke. It can easily be scraped with a knife into powder which, if sprinkled over red-hot coals, changes instantaneously into thick vapours, at first with a slight yellow colour, with a strong aromatic smell, somewhat similar to that of incense. Large pieces brought into contact with a light soon burn up, developing at the same time the above-mentioned vapours. When chewed, it crackles between the teeth, without leaving a noticeable taste. Whether Gum Copal has ever been subjected to a thorough chemical analysis I do not know; but no notice or account of it is given in the 'Histoire des Drogues,' by Guibourd, in which work are found the analyses of many East-Indian and American Copal resins. The fact that there is often seen, even on the canted broken sides of many pieces, the same hard, whitish, earthy crust which covers the other unbroken surface of the same piece, tends to prove that after their falling off the mother tree they were forcibly transported from their original spot by floods or earth-falls, by which they were broken before they came into the marl or sandy plains in which they are now found. At times the crust just alluded to is very hard, of considerable thickness, and with a glossy polish, which leads to the supposition that pieces in which it is found have been imbedded for a long time in the ground, or perhaps in water-basins. Whilst an earthy crust of greater or less thickness is noticed on all pieces of Gum Copal before it is washed or rubbed off, the colour in different pieces varies very much; some samples are yellowish-

white, some of honey or gold-colour, and others are distinguished by an intense reddish orange-colour. The general appearance of the pure pieces of this resin, especially the gold-coloured kind, has a delusive resemblance to Amber, with which, though much softer, it has the common properties of igniting and of becoming electrical by friction. I am satisfied that the Angola Copal is capable of being used and worked up into ornamental articles in the same way as Amber, from a specimen which was finished by a turner at Loando, who had but a scanty knowledge of the treatment of Amber. The interior of the Angola Copal pieces, when not mixed with earthy substances, or with remains of bark, is even glossy and transparent; but I have never observed insects in any of the numerous samples which, partly in Angola and partly at Lisbon, came under my notice; whilst in the Copal sent to Lisbon from the province of Mossambique, on the east coast of Tropical Africa, various hymenopterous insects are to be met with. The different colours of the Copal of Angola just described are connected, more or less, with its availability for varnishes, &c. Thus the Copal-dealers distinguish three sorts, viz.:—

1. Red Copal Gum (Gomma Copal vermellia).
2. Yellow (G. C. amarella).
3. Whitish (G. C. bianca).

The red and reddish sorts furnish the best and finest varnish, and therefore are most in request and the dearest, whilst the whitish quality is sold at the lowest price.

Shortly before I left Loando, the market-value of the different qualities was stated, in the Price Current issued by the Chamber of Commerce, as follows:—

1. Gomma Copal vermellia 1 arroba (32 lb.) = 6500 reis*.
2. Gomma Copal amarella 1 arroba = 5500 to 6000 reis.
3. Gomma Copal bianca 1 arroba = 3000 to 3500 reis.
4. Gomma Copal picada 1 arroba = 2000 reis.

The last named chiefly consists of the smaller soiled pieces of the three better qualities.

The export of Gum Copal from Angola as an article of trade commenced, as stated by the register of the Custom House (Alfandega Grande), during the years 1820–1825; but it is not until 1825 that any considerable quantity (e. g. 833 lb.) is quoted as having been imported thence. From that time the export of Gum Copal from Angola has increased from year to year; so

* Exchange: 7000 reis Angola are equal to 4500 reis Lisbon value, or £1 sterling.

that it amounted in 1844 to 8600 arrobas (=275,200 lb.), and in the year following, 1845, it reached 24,000 arrobas (=768,000 lb.). During the years 1850 to 1859 there was exported from Benguella alone, on the average, the enormous quantity of 50,000 arrobas (=1,600,000 lb.) per annum; so that the total yearly export of Gum Copal from all the districts of Angola together may be estimated at 2,000,000 lb. It is obvious that there must be a great difference in the export in different years, because the finding of the article depends on chance, and the gathering of it has often to be given up for a lengthened time, in consequence of the ravages of the neighbouring warlike negro tribes, or on account of other unfavourable circumstances. Moreover the quantity exported varies according to the demand for the article existing in different countries, which, when increasing, runs up the prices and stimulates the Copal-gatherers to greater activity in their researches.

Part of this rich yield is shipped direct to European ports, another portion is sent *viâ* Lisbon; but the largest quantity is bought up in the various seaports of Angola by North American merchants. If we consider that not only from Angola, but also from most of the commercial towns on the west coast of Tropical Africa, more or less Gum Copal is exported every year, we can form an approximate idea of the enormous stock of this valuable resin treasured up in the respective districts of the African continent; and the question arises naturally—

III. *What is the origin of Gum Copal in West Africa in general, and especially of that found in Angola?*—That the resin in question is an exudation from some tree, is shown not only by its resemblance to many other tree-resins, but also by the remains of bark visible on the surface of many pieces, and further by the fact that some of them clearly exhibit a concave mark, where bark is observed; and we may presume that in these places they were originally attached to the trees before falling off. I have seen several samples so perfect in this respect that, from the arc of the concavity, the diameter of the tree or branch from which they came might be determined with considerable exactness. Whether or not all the varieties of West African Gum Copal above mentioned, which differ in colour and mercantile value, are produced from one species or from several species of trees, is a question which cannot be settled with any degree of certainty until the origin of some one or other variety has been traced. Here, however, I must premise that I have often noticed on pieces of Copal

a clear transition of colour from white to yellow, and from yellow to red; which leads me to the supposition that the different colour is rather to be attributed to the age of the tree from which the Copal came, or to the condition of soil in which the tree grew, or to other climatological causes, than to a specific difference among the gum-yielding trees. For the present the most important question is whether the Gum Copal exported for so many years from Angola and other tropical countries on the west coast of Africa is still produced by trees, or whether it is to be considered (like Amber) a fossil resin which was produced in former geological epochs of the African continent, or from trees which either do not now exist at all, or of which only a few scanty fossil remains are to be met with. Although, from my own observations during my residence in Angola, I am firmly of opinion that the Angola Copal is a fossil resin, I think it right to mention and comment upon the opinions and statements of those writers and travellers who assert that the resin is derived from living trees. Oliveira Pimental, a learned Portuguese chemist, maintains, in a paper published at Lisbon in 1852*, that Gum Copal comes from the *Hymenæa verrucosa*, Lam. But this tree, which is also described by Hayne† as *Trachylobium martianum*, and which has been classified by Mr. Bentham as *Cynometra Spruceana*, has never been found in Africa at all; it is an American tree, and can consequently in no way be regarded as the mother plant of the Angola Copal. Ladislaus Magyar, a Hungarian traveller in South Africa, who during his journey often met with Copal-gatherers, asserts with great precision‡ that the *Acacià nilotica*, which grows in abundance on the mountains behind the town of Benguella, furnishes the Gum Copal. Leaving out of the question whether the *Acacia nilotica* really occurs in the district of Angola, I cannot refrain from remarking that a traveller who finds in the forests of Tropical África species of *Platanus*, *Cornus*, *Quercus*, *Populus*, &c., with *Heliconiæ*, *Tillandsiæ*, and creeping *Tagetes*§, can hardly expect us to believe his botanical assertions. It seems more likely that Magyar confounded Gum Copal with other gums, or perhaps in his inquiries as to its origin he was intentionally deluded by the negroes, who carefully try to keep secret the places where Copal is found. To the

* Relatorio da Exposiçao agricola dc Lisboa, 1852, p. 51.

† Arzneigewächse, xi. tab. 17.

‡ Magyar hazlò clelatricai Utazasai & Pesth, 1859, German edition, p. 59.

§ *L. c.* pp. 57, 61, 235, 231, &c.

two foregoing but little-trustworthy statements regarding the origin of the Gum Copal I will add a third, which, from the high scientific authority of the reporter, would be fully believed, if the reasons upon which the author bases his statement did not prove totally erroneous. Dr. Klotsch, who, it is known, has described the greater portion of the plants collected by Dr. Peters in the province of Mozambique, asserts * that all African Copal originates from *Trachylobium Mossambicense,* and perhaps also from *T. Hornemanianum,* Hayne, trying to make it appear that no Gum Copal whatever occurs on the west coast of Africa, because, as he says, no mention is made of a tree in "Hooker's Niger Flora" from which the Copal could be gained. But as I have proved that by far the largest quantity of African Copal is not only exported from the tropical west coast of that continent, but also that it is really found and constantly gathered there, and, further, as the *Trachylobium Mossambicense,* Klotsch, has hitherto nowhere been found on the entire western coast of Africa † by any one of the numerous scientific travellers who have visited that country, nobody will hesitate to regard Dr. Klotsch's view as erroneous; and I may therefore dispense with any further discussion of it. I doubt whether even the Copal exported from the east coast of Africa comes solely from *Trachylobium Mossambicense* (Klotsch), as some kinds of the Copal which come from Mozambique bear a delusive resemblance to the Animi resin found in the East Indies, and this latter resin, according to several trustworthy reports ‡, is not obtained from *Leguminosæ* but from the *Vateria Indica, L.,* a tree belonging to the family of *Dipterocarpeæ,* and, like the Copal of Mozambique, it occasionally has various insects imbedded in it. The peculiar designs appearing on many samples of the Mozambique Gum Copal, which extend with great regularity over a part of the surface, and which look like the rough side of a rasp, might be a hint for tracing its origin; but some very experienced botanists and pharmaceutists to whom I have shown them have as yet not explained them. I may, I think, pass by the notices respecting the origin of the West African Copal which have hitherto appeared in pharmaceutical works published in England, Germany, and France, as most of them are founded on uncertain data and suppositions or are simply compilations

* Dr. W. Peters, Reise nach Mossambique, Bot. i. p. 22.

† *Vide* Bentham et Hooker f., Genera Plantarum, vol. i. p. 583.

‡ Wight, Illustrations of Indian Botany, i. p. 86; Lindley, Veget. Kingdom, p. 394.

from older works which belong to a time when but a few coastal settlements of the tropical part of the African continent were accessible to scientific exploration. An honourable exception among these publications is the paper by Dr. Daniell*, in the London Pharmaceutical Journal, which contains some very interesting genetical and mercantile data in relation to the gum resin of Tropical West Africa. This paper has all the more claim for consideration and critical estimation, because the author resided personally as physician for several years in different places in West Tropical Africa, and it may be admitted that his views are founded more on his own personal experience than on the communications of others. Dr. Daniell divides all the Copals which come into the trade into East-Indian, American, and African; and amongst those of the western coast of Africa he distinguishes the Copal of North Guinea from that of South Guinea: but as many kinds of gum, as well as Copal resin, are found both in the countries north and south of the equator, the basis of this division is deficient. Still less correct is the subdivision by the author of the South-Guinea Copal into Congo-Angola and Benguella Copal. It seems that he was not aware that several coast factories in Congo receive a large portion of their Gum Copal from different districts of Angola, and that the factories in Angola often have their stores furnished from the branch factories in Congo as well as Benguella. However, special attention should be paid to Dr. Daniell's communication on the origin of the Sierra-Leone Copal, where he speaks of a particular tree as yielding the resin, which he represents to be the *Guibourtia copallifera* described by Mr. Bennett in the 'Journ. Linn. Soc.' vol. i. p. 150, and which, in a late publication by Mr. Bentham, is said to be a species of *Copaifera*, Lin., and is described by him as the *Copaifera Guibourtiana*, in the last published part of the 'Linnean Transactions.' According to Dr. Daniell, this tree grows in the higher mountain-forests near Sierra Leone, and is conspicuous by its peculiar inflorescence and its bifoliated leaves; but he does not state whether he saw the trees *in situ* with the gum sticking to them, or whether he only received branches of the tree from negroes; and as regards the fruit of the tree, he admits he has described it only by hearsay.

With reference also to the Copal resin furnished by the *Guibourtia*, he appears not to have been quite certain whether all the kinds described by him belong to the same species; for after

* Pharmaceutical Journal and Transactions, 1857, vol. xvi. p. 367.

having described one of these kinds of Copal he adds, "The tree, independently of the ordinary Copal, affords other inferior sorts gathered from the trunks and branches of young or immature production;" and of these inferior sorts he says again in the next few lines, "It is not improbable that different species of *Guibourtia* may yield this resin, which, however, at present remain undiscovered."

Leaving the reader to form his own conclusions from the passages I have quoted, I cannot help drawing attention to another passage in the same author's statements, where he speaks, of the Copal which is brought by coasters from the rivers Malaenzi and Pongas to Sierra Leone, in the following manner:—"Considerable quantities, the accumulation of years, are regularly washed down by the heavy currents of the rainy season from the mountain-slopes, in the soil of which they were imbedded, and are consequently gathered in the bed or on the banks of rivers"*.

This passage clearly proves that a considerable quantity of the Gum Copal exported from Sierra Leone is not gathered from trees, but is washed to the surface of the soil by the heavy rains, and is found on the banks of rivers or streamlets. Thus, like the Gum Copal of Angola, its origin is unknown, and, according to the author's own admission, it is (like the Gum Copal of Angola) much clearer than the Copal resin said to be gathered off trees in the neighbourhood of Sierra Leone. My own stay in Sierra Leone was, to my regret, too limited, and I had no opportunity of making the necessary researches respecting the origin of the Copal resin exported from that colony; but what I heard about it from several natives, and also from a German merchant settled there, quite agrees with the statement of Dr. Daniell just cited. Although I have not the slightest doubt that the *Guibourtia copallifera* really furnishes a Copal resin valuable in trade, still it is clear, from the last quoted passage of Dr. Daniell's paper, that a considerable portion of the Gum Copal of Sierra Leone is found stored in the earth, of which the origin is as yet totally unknown.

If the foregoing statement of Dr. Daniell respecting the origin of the Sierra-Leone Gum Copal is considered insufficient, his assertion about the origin of the Angola Copal will be found still less satisfactory, because, although he himself has resided for some time in Loanda, he admits that he obtained his information partly from

* *L. c.* p. 371.

the natives and partly from the work 'Ensaios,' by José da Lima—a book which does full credit to the author's diligence and patriotism, but which in its comments on the natural productions of Angola and their origin is thoroughly unscientific.

We can hardly agree with what Dr. Daniell says about the origin even of the softer gum resins enumerated by him under the name of Gum Animi, as he appears to have obtained them from the *Hymenæa Courbaril*, or from another kindred species, and which, as he says, is abundant in Senegambia. But neither the *Hymenæa Courbaril* nor any other species of this genus (of which at present eight are known) has ever been found on the African continent; on the contrary, they all belong to the flora of America, and therefore cannot be taken into account when the origin of the African gum resin is in question.

Having now reviewed the various opinions of African travellers and other scientific authorities, I shall proceed to consider the ideas prevalent among the natives themselves respecting the origin of Gum Copal in Angola. Many of the natives maintain that the Copal still grows on different trees, but that it acquires its excellent qualities as a useful resin by dropping off and sinking several feet deep into the soil, whereby it is cleaned, and obtains, after the lapse of many years, its hardness, inflammability, and transparency. This opinion (which, if correct, would show some analogy between the formation of Copal and that of coal) was not communicated to me by native Africans alone, but also by some European settlers in Loando, Ambriz, and Benguella. If a portion of this Ethiopian hypothesis is wholly erroneous, still the other clearly indicates that the inhabitants of the country themselves, where the Gum Copal is gathered, look upon it as a kind of fossil production.

In April 1854, shortly after my arrival on the west coast of Africa, at a time when I hoped to find the Gum-Copal tree still in existence, I was told by a native of some education that Gum Copal was furnished by certain trees called by him Muve, growing near the Cabo Lombo, eight to ten miles south of Loando, where I might find a small quantity, although perhaps in an immature condition. This statement was corroborated shortly afterwards by a European druggist established in the same town, and who was considered somewhat learned by his fellow citizens. I therefore immediately started off for the spot indicated. I found, however, only a few scattered trees of the Combretaceæ family, certainly exhibiting some blackish gum; but this gum, when mas-

ticated or placed in water, quickly dissolved, showing, to my great disappointment, that it was not a resin, still less Gum Copal. When I mentioned my failure to my informers on my return to Loando, both of them asserted that the gum which I had found really was young Gum Copal, but that it must first fall off the tree, penetrate into the ground, there ripen, and be transformed into real Copal. Nearly the same thing happened to me in September 1857. Descending from the highlands of Inner Angola into the coastal region, I met one evening a party of Gum-Copal gatherers encamped round a fire, sorting Copal collected during the day. I immediately ordered my caravan to stop for the night and to put up near the party, fully hoping that I should be certain now to find out the Copal-tree. Having saluted my heroes with the friendly "Bocuetu" of the Bunda dialect, treating them also to a few glasses of rum, I gradually turned the conversation to the place where they had found the Copal. After some hesitation, one of the elder negroes said that the Copal in their possession had been collected in wooded sand-hills near Mongolo, a station which I had passed with my caravan in the morning. The half-starved condition of my caravan did not admit of my interrupting my journey for several days by a retrograde march; nevertheless I determined to visit on the next day the spot indicated by the Copal-gatherers; and by giving them a few presents I induced two of the party to accompany me. We arrived there in five hours, about noon. Before we came to the forest which adorns the heights of the sand-mountains, which are intercepted here and there by plots of marl-stone, I observed that the sand had been freshly dug up in many places; and I felt convinced that the negroes had not deceived me, but had really brought me to the place of their operations on the previous day. This Copal-field extended almost into the middle of the forest, which (although in some places *Celastrus*, *Diospyrus*, *Combretum*, and a few Acacias were seen) consisted chiefly of a tree I had formerly met with in isolated groups in the district of Golungo Alto, and more frequently in the district of Cazengo, and which is called by the natives Calalanza*.

* This tree, which only occurs here and there throughout the forests in the districts of Golungo Alto and Cayenzo, but which covers large tracts in the lowest littoral region, especially on the lower edge of the primitive-forest region, belongs to the Leguminosæ; and Mr. Bentham, to whom I submitted flowering specimens, has described it as a new species of *Cynometra* [*C. laxiflora*]. See Transactions of the Linnean Society, vol. xxv. p. 318.

Now this was pointed out to me by the two Copal-gatherers as the Copal-yielding tree. I tried hard to discover some resin on any one of them, but without success. My companions were not in the least concerned or confused, but assured me that the exuded Copal was washed off by the heavy rainfalls and, after sinking into the soil, ripened there and came to perfection; so I had to regret that, in this instance also, my researches led only to a negative result. Several subsequent attempts that I made in the districts of Benguella and Mossamedes yielded the same negative result. At one time I was inclined to believe that the tree which yielded the large quantity of Copal found was either very scarce or probably no longer existed.

After the foregoing remarks I may perhaps assume with some certainty that the West African Copal, and probably all gum resin exported under this name from Tropical Africa, may be looked upon as a fossil resin produced by trees which, in periods long since past, adorned the forests of that continent, but which at present are either totally extinct or exist only in a dwarfed posterity. As evidence in support of my views I should point, in the first place, to the petrified crust on the surface of this Copal; next, to its admitted occurrence in the earth, often at a considerable depth; and lastly, to its great resemblance to amber. Besides this positive evidence, I may also be permitted to establish my views inductively in a negative manner. If we consider the large quantity of Copal gathered in Angola and all along the coast of Tropical West Africa, we are led naturally to the conclusion that the trees yielding it could not be scarce if still in existence, but ought to be abundant and widely distributed, and that the Copal resin produced by them must be enormous and could not well escape observation; and yet, favoured by circumstances as I was during several years of residence in and travel through most of the districts of Angola, I could not find out even a single living tree with resin similar to Gum Copal: I am therefore confirmed in my opinion that the tree in question must be either very scarce or, what is more probable, is extinct, and that West African Copal is really a fossil resin. That of these Copal-yielding trees (which certainly at one time must have been growing in large numbers in and near the widely extended region where Copal is so abundantly found at present) only a few fragmentary remains of bark should have hitherto been discovered is the less surprising, if we take into consideration that Tropical Africa, the home of this Copal, is at the present moment the least-explored continent, and, further,

bear in mind that when another analogous resin, amber, became known and brought into practical use, more than 500 years elapsed before the learned Dr. Goeppert (whilst pointing to its fossil nature) succeeded with some degree of probability in tracing its origin to coniferous trees.

Remarks on the genus *Moringa*. By N. A. DALZELL, Esq., Superintendent of the Botanical Gardens, Bombay.

[Read Dec. 7, 1865.]

IT is surprising that no botanist who has discussed the affinities of the curious genus *Moringa*, has noticed the very remarkable resemblance of the ripe capsule to the fruit of the *Bignoniaceæ*.

In both it is a long slender pendulous capsule, with winged seeds seated in cavities of the corky placenta. Both have exalbuminous parietal seeds, with the radicle next the hilum.

Though generally the seeds of *Bignoniaceæ* are transverse, yet *Moringa* agrees with the tribe *Incarvilleæ* in having the seeds pendulous, while in the amygdaloid character of the cotyledons *Moringa* resembles *Oxycladus* (Miers) and *Crescentia*.

In habit, foliage, and inflorescence there is a great resemblance between *Moringa* and *Bignoniaceæ*—so much so that one species of *Bignonia* is called by De Candolle *Moringæfolia*. If the leaves of *Moringa* and *Millingtonia hortensis* are placed together, a peculiarity is observable common to both, and which is scarcely to be found in any other family. It is this, that the lowest pair of the ultimate pinnulæ are trifoliolate, the odd one being larger than the lateral pair. In *Moringa* the leaves of the plumule are triternate, and the cotyledons in germination do not rise out of the ground. The leaves of *Moringa* are alternate; but they are also alternate in *Spathodea* and some others.

Before discussing the structure of the flower in *Moringa*, I must point out another feature in the resemblance between this and *Bignoniaceæ*, of no ordinary value, viz. that the testa of the seed (not of the wings) is beautifully reticulated: to observe this, a very thin shaving of the testa must be examined by transmitted light: and this reticulation is one of the marks of the *Bignoniaceæ*.

Description of the flower of *Moringa*:—

Calyx with imbricated æstivation, the entire portion cup-shaped, oblique, the anterior being only half the depth of the posterior side. The odd sepal is posterior, and the five divisions reflexed, and coloured as in *Eccremocarpus*, *Fridericia*, *Solenophora*, &c.

Corolla.—*Moringa* is said to be polypetalous; but I consider it gamopetalous—the entire portion lining the calyx-tube, the divisions (petals) reaching down as far as the entire portion of the calyx, and thus making a near approach to *Platycarpum*, in which there is scarcely any entire portion above the calyx. Wight and Arnott, in their description of *Moringa*, have described the odd petal as posterior, whereas in reality it is anterior.

This anterior division of the corolla is larger than the others, as in *Stereospermum* and many *Bignoniaceæ*.

Wight and Arnott make mention of a fleshy torus; and Bentham and Hooker describe this as a fleshy disk with a free margin lining the tube of the calyx.

There appears to me to be no such disk with a free margin,—the so-called disk consisting of the consolidated bases of the two filaments of the flower, the vessels of which can be traced upwards from the bottom of the calyx-tube continuously through the filaments.

Stamens.—These are described as ten in number, five of the number being imperfect and alternate with five which are fertile. But no one appears to have noticed that four of these fertile stamens are didynamous, the anthers being brought together in pairs, and the filaments having that peculiar arcuate form necessary to effect this arrangement, while the fifth and posterior odd stamen, so generally rudimentary in *Bignoniaceæ*, is here similar to the others and longer, as in *Kigelia* and *Calosanthes*.

Had Linnæus observed this, he must have placed *Moringa* in his class Didynamia.

In *Bignoniaceæ* the four or five fertile stamens are opposite the segments of the calyx; and five glands, sometimes assuming the shape of filaments, surround the ovary and alternate with the stamens. In *Moringa* there appears to be a transposition of development, so to speak; for while in *Bignoniaceæ* it is the outer series that become perfect stamens (the inner series being glands), in *Moringa* it is the inner series that become perfect stamens, while the outer remain as glandular bodies, being destitute of the essentials of a stamen.

The filaments of *Moringa* are hirsute at the base, as they are in nearly all the *Bignoniaceæ*.

These remarks on the stamens seem to derive confirmation from a remark of Griffith's (Posthumous Papers, vol. ii. p. 228), where he says, "*Bignonia* with fifteen stamens may be expected; and what is singular, if such is found, the additional stamina

opposite the existing five will be more developed, in compensation perhaps for the great development of the corolla."

As regards the one-celled anthers of *Moringa*, we find them in *Jacaranda*, *Colea*, and still more general in the allied *Cyrtandraceæ*; in fact the anthers of *Isanthera* and *Didymocarpus* are identical with those of *Moringa*.

The tricarpellary fruit of the Moringa presents no greater difficulty than the case of dicarpellary fruit of *Affonsea* in *Leguminosæ*; nor can it be thought strange that flowers formed on a quinary type should have any number of carpels below six; and although among corollifloral orders a tricarpellary ovary is not common, yet it occurs in *Solaneæ*, *Polemoniaceæ*, &c., and I have observed the same frequently in the genus *Gesneria*. *Aceraceæ* have a two-celled fruit; and they are closely related to *Sapindaceæ* with a three-celled fruit.

For the reasons stated I have come to the conclusion that *Moringa* should be placed in the Bignonieal alliance.

If the structure of the foliage, the seed, and the seed-vessel is important, we find that in this point there is a wonderful correspondence, and that the apparent discrepancies are greatest in points of least importance. Such is the perfect union of the corolla and calyx-tube in *Moringa*, while in the *Bignoniales* these parts are free.

It may well be a question, under the above view, why Willdenow should have placed the genus *Anoma* of Loureiro under *Hyperanthera*, had there not been a sufficient number of resemblances between it and *Moringa* to justify this step.

Were something more known of *Anoma*, it might turn out to be a typical species of *Moringa* with two-valved fruit and showing a still closer resemblance to the *Bignoniaceæ*.

What is the *Trigonocarpus* of Wallich? which has been placed among the *Bignoniaceæ*.

Florula of Banda. By M. P. Edgeworth, Esq., F.L.S.

[Read Jan. 18, 1866.]

I beg leave to lay before the Society a list of plants collected by me during a residence in the district of Banda in Bundelcund, during the years 1847–8–9, almost exactly two years.

This list was originally published as an appendix to a statistical report called for by the Government, and printed in the 'Journal

of the Asiatic Society' in 1850. But now that I have had the opportunity of collating my specimens with those of the herbarium at Kew, I find so many errors or changes in names, that I think it advisable to lay this corrected list before the Society.

The district of Banda forms an irregular triangle, bounded on the north and north-east by the river Jumna, on the west and south-west principally by the river Ken (or Cane), and to the south by the second ridge of low hills, forming the flank of the tableland of Bundelcund.

The actual area is 2174 square miles. Lat. 25° 10′ to 26°; long. 80° 20′ to 81° 50′. The elevation above the sea is from 450 to 1500 feet. The highest trigonometrical station is 1519½ feet.

The northern portion of the district is flat, but seamed with deep ravines and the courses of the numerous small rivers which run parallel to the Ken and into the Jumna (such as the Bághin, Pysani and others), with remarkable isolated rocks of granite or syenite, which rise like islands in the surrounding level plain of black soil, like those described by Humboldt in his 'Asie Centrale.'

The general aspect of the country is extremely fertile, and, in the southern and eastern portion, exceedingly beautiful—rich cultivated plains, dotted with noble trees, solitary or in groves, broken with rugged hills, and occasionally with large tanks or clear streams.

The southern portion of the district is hilly, termed Patha, less fertile, and much overrun with jungle (principally *Acacia catechuoides*), with a shallow soil on a sandstone substratum. It is diversified with hills, and, though less rich, it is by no means devoid of beauty.

There are fine waterfalls (in the rainy season); and in these chasms we find a few mosses and ferns, which are also to be found at the mouth of a very remarkable hole, called Biradhkund, in the tableland. It resembles a gigantic well or shaft of a mine, about 203 feet in diameter, and estimated at 600 or 700 feet in depth. Unfortunately I never had an opportunity of returning to the spot to make further examination and measurement. A friend, who afterwards went at my request, was prevented by the swarms of bees, which build their hives on almost all the scarped rocks of the country, and which fringe the hole.

This list by no means forms a complete flora of the district, as I had no means of exploring the further portions in the rainy season, when, of course, the most remarkable flowers would be

found, and I never was able to procure any one to collect for me: every specimen was collected by my own hand.

This district is just on the border of the great botanical region of Central India, but retains some of the characters of the Gangetic Doab, from which it is separated by the river Jumna.

The following may be noted as characteristic of the "black soil" so abundant in central India, which here makes its first appearance:—*Biophytum sensitivum*, *Psoralea corylifolia*, *Indigofera glandulosa* and *paucifolia*, *Alysicarpus longifolius* and *Heyneanus*, *Desmodium diffusum*, *Cassia auriculata*, *Amberboa Indica*, *Ipomæa renifolia*, *Sutera glandulosa*, *Stemodia villosa*, *Sopubia delphiniifolia*, *Euphorbia rosea*, *Ophiurus corymbosus*.

The total number of Phanerogamæ collected is 776, of which 166 were cultivated only, leaving 610 to be regarded as the true flora of the district. Of these, 18 (or 3 per cent.) are aquatic, 84 (or 14 per cent.) riparious or marshy, 65 (or 11 per cent.) annuals in fields, of which 22 are found in the spring crops or "rubby." Shrubby plants form a proportion of 31 per cent., being 187.

The largest orders are:—

Gramineæ	102 or	16	per cent.
Leguminosæ	85 or	14	„
Compositæ...........	42 or	7	„
Acanthaceæ	30 or	5	„
Euphorbiaceæ	24 or	4	„
Convolvulaceæ	20 or	3·3	„

after which come the Asclepiadaceæ, Labiatæ, Boragineæ, Cyperaceæ and Urticaceæ.

The most prolific genera in species are *Panicum*, *Eragrostis*, *Andropogon*, *Cyperus*, *Ficus*, *Euphorbia*, *Ipomæa*, *Alysicarpus*, and *Indigofera*.

It is worth while to remark the difference in the percentages of the principal orders between the flora at Banda and that at Multan.

	Banda.	Multan.
Aquatic	3	2
Riparious............	14	10
Annuals	11	20
Shrubby	31	13·3
Gramineæ	16	24
Leguminosæ..........	14	10

	Banda.	Multan.
Compositæ	7	5
Acanthaceæ	5	1
Euphorbiaceæ	4	1·8
Convolvulaceæ	3·3	3·3
Boragineæ	2	3·6
Scrophularineæ	2	3·3
Amarantheæ	1	3·7
Cruciferæ	0·1	3·3

In my former list, published in the 'Journ. As. Soc. Calcutta,' I described several species as new; but most of them I have now referred to previously described species. Those few which still appear to me undescribed are appended.

Temperature for two years. (Thermometer on a north exposure.)

Average from April 1847 to March 1849.	Means.				Extremes.	
	Min.	Max.	Mean.	Wet-bulb.	Min.	Max.
January	48·5	73·6	61·4	17	35	82
February	52·5	76·3	69·9	12·3	44	96
March	69·	96	82·5	6	61	104
April	82·2	105·3	94·0	3·5	75	110
May	86	107·4	96·6	5	78	114
June	86·4	106·7	96·3	7·2	78	112
July	80·1	96·5	88·6	3	70	108
August	78·7	91·6	85·2	4	74	100
September	76·9	92·5	84·7	4	73	100
October	71·2	90·0	81·5	5	64	98
November	58·1	78·1	71·2	12·5	49	87
December	51·8	76·2	63·5	16·5	41	82
Average			87			

	Spont.	Cult.	Total.
Thalamifloræ.			
Ranunculaceæ	1	1	2
Anonaceæ	1	1	1
Magnoliaceæ......	..	1	1
Menispermaceæ ..	3	..	3
Nymphæaceæ	1	..	1
Nelumbiaceæ	1	..	1
Papaveraceæ	2	1	3
Cruciferæ........	1	7	8
Capparideæ	8	..	8
Bixineæ	2	..	2
Violaceæ	1	..	1
Polygalaceæ	2	..	2
Elatinaceæ	1	..	1
Portulaceæ	1	1	2
Caryophyllaceæ ..	3	..	3
Tamariscineæ	2	..	2
Linaceæ	..	1	1
Malvaceæ	18	6	24
Byttneriaceæ	8	2	9
Tiliaceæ	13	1	13
Aurantiaceæ......	2	7	7
Malpighiaceæ	1	1	2
Meliaceæ	1	2	2
Sapindaceæ	1	1	2
Oxalideæ	2	1	3
Balsamineæ	..	1	1
Zygophyllaceæ....	1	..	1
Simarubaceæ	1	..	1
Xanthoxylaceæ ..	..	1	1
Ampelideæ	3	1	4
	81	37	112
Calycifloræ.			
Celastraceæ	2	..	2
Rhamnaceæ	5	1	6
Anacardiaceæ	5	1	6
Moringaceæ	..	1	1
Leguminosæ......	84	32	110
Rosaceæ	1	1	2
Combretaceæ	1	1	2
Granateæ........	..	1	1
Onagraricæ	2	1	3
Lythraceæ	7	1	8
Alangiaceæ	1	..	1
Myrtaceæ........	1	3	4
Cucurbitaceæ	10	10	20
Aizooneæ	1	..	1
Saxifragaceæ	1	..	1
Umbelliferæ	1	6	7
Loranthaceæ	2	..	2
Rubiaceæ........	9	2	11
Compositæ	42	4	46
Campanulaceæ....	2	..	2
	177	65	236

Corollifloræ.	Spont.	Cult.	Total.
Primulaceæ	2	..	2
Myrsinaceæ	1	..	1
Ebenaceæ	3	..	3
Sapoteæ	2	2	3
Jasminaceæ	1	5	5
Apocynaceæ......	8	5	12
Asclepiadcæ	13	2	15
Gentianeæ........	6	..	6
Bignoniaceæ.. ...	5	1	6
Pedalineæ........	..	3	3
Convolvulaceæ....	19	6	25
Cordiaceæ	1	1	2
Boragineæ	12	..	12
Hydroleaceæ	1	..	1
Scrophularineæ ..	13	..	13
Orobancheæ......	1	..	1
Solanaceæ........	6	4	10
Acanthaceæ	30	1	30
Verbenaceæ	6	1	7
Labiatæ	13	4	17
Plumbagineæ	1	..	1
Sphenocleaceæ....	1	..	1
	145	35	176
Monochlamydeæ.			
Phytolaceæ	1	..	1
Salsolaceæ........	..	4	4
Amaranthaceæ	7	4	11
Nyctagincæ	2	1	3
Polygonaceæ	4	..	4
Laurineæ	1	..	1
Aristolochiaceæ ..	1	..	1
Euphorbiaceæ	24	4	27
Piperaceæ........	1	1	2
Ulmaceæ	1	..	1
Juglandaceæ......	1	..	1
Urticaceæ........	11	3	14
Salicineæ	1	..	1
Undetermined....	4	..	4
	55	17	75

Endogens.	Spont.	Cult.	Total.	Endogens.	Spont.	Cult.	Total.
Palmæ	..	2	2	Hydrocharideæ	4	..	4
Pandaneæ	..	1	1	Dioscoreaceæ	2	1	3
Aroideæ	1	1	2	Liliaceæ	2	7	9
Lemnaceæ	1	..	1	Juncaceæ	1	..	1
Naiadaceæ	2	..	2	Alismaceæ	2	..	2
Musaceæ	..	1	1	Commelynaceæ	7	..	7
Cannaceæ	..	1	1	Eriocauloneæ	1	..	1
Zingiberaceæ	1	2	3	Cyperaceæ	12	..	12
Orchideæ	2	..	2	Gramineæ	102	15	117
Amaryllideæ	1	5	6				
Iridaceæ	..	2	2		141	38	179

List of plants found in the Banda district, 1847–9.

THALAMIFLORÆ.

Ranunculaceæ.

Ranunculus sceleratus, abundant in streams, &c.

Delphinium Ajacis, gardens.

Anonaceæ.

Anona squamosa, gardens, and apparently wild in the hills of Kálinjur and Murfa.

Magnoliaceæ.

Michelia Champaca, gardens.

Menispermaceæ.

Cocculus villosus, abundant.

Tinospora cordifolius, rocks in Kaliangurh, sending down immensely long roots from above.

Cissampelos Pareira, not common.

Nymphæaceæ.

Nymphæa Lotus, ponds, common.

Nelumbium speciosum, rare.

Papaveraceæ.

Argemone mexicana, most abundant.

Papaver somniferum, cultivated.

Fumaria parviflora, corn-fields.

Cruciferæ.

Cochlearia alyssoides, mud of rivers &c.

Lepidium sativum, cultivated.

Eruca sativa, cultivated.

Brassica oleracea, cultivated.

Sinapis dichotoma, cultivated.

S. glauca, cultivated.

S. ramosa, cultivated.

Raphanus sativus, cultivated.

Capparideæ.

Mærua oblongifolia, rocky hills.

Cratæva religiosa, rocky hills and in gardens.

Capparis sepiaria, not common, Rasin hill Chetarkot, near the Jumna.

C. horrida, rare.

C. aphylla (*Sodada decidua*), rare.

Polyanisia viscosa, fields.

P. Chelidonii, marshes.

Gynandropsis pentaphylla, abundant.

Bixineæ.

Cochleospermum gossypium, table-land.

Flacourtia Ramoutchi, rocky hills.

VIOLACEÆ.

Ionidium suffruticosum, common.

POLYGALACEÆ.

Polygala serpyllifolia, common.
P. Rothiana, common.

PORTULACEÆ.

Portulaca meridiana, common.
P. oleracea, cultivated.

CARYOPHYLLACEÆ.

Mollugo striata, rocky hills.
Polycarpæa corymbosa, fields.
Hapalosia Lœflingii, bank of Ken.

TAMARISCINEÆ.

Tamarix dioica, Jumna.
Trichaurus ericoides, Ken at Ramgarh.

ELATINACEÆ.

Elatine ammannioides, wet places.

LINACEÆ.

Linum usitatissimum, cultivated.

MALVACEÆ.

Malvastrum tricuspidatum, in the hedge of a garden.
Althæa Ludwigii, dried ponds.
Sida spinosa, common.
S. rhombifolia, common.
S. cordifolia, common.
S. humilis, common.
Abutilon indicum, common.
A. asiaticum, common.
A. polyandrum, Abharkun Kaliangurh.
A. ramosum, gardens.
Lagunea lobata, rocky hills.
Hibiscus Rosa-sinensis, gardens.
H. tubulosus, corn-fields.
H. cannabinus, cultivated.
H. vitifolius, hills.
H. hirtus, hills, and with white flowers.
H. parviflorus, not uncommon.
Abelmoschus esculentus, cultivated.
A. ficulneus, not uncommon.
A. cancellatus, rocks.
Pavonia odorata, not rare.
Gossypium herbaceum, cultivated.

STERCULIACÆ.

Bombax heptaphylla, wild and cultivated.
Adansonia digitata, Kallenjur, gardens.
Helicteres Isora, on every hill.
Sterculia urens, on every hill.
Melhania abutiloides, Sehonda hill.
Riedleia corchorifolia, fallows.
Waltheria indica, hills.
Pentapetes phœnicea, marshes.
Byttneria aspera, Patha.

TILIACEÆ.

Corchorus acutangularis, fields.
C. trilocularis, fields.
C. olitorius, fields.
C. tridens, fields.
C. capsularis, fields.
C. fascicularis, edges of ponds.
Triumfetta angulata, common.
T. rotundifolia, barren places.
Grewia polygama, Rasawra jungle.
G. pilosa (*Lam.*), Kurthal hill.
G. Rothii (*Wost.*), Kurthal hill.
G. tiliæfolia, Kurthal hill.
G. asiatica, cultivated, and wild in the hills.

AURANTIACEÆ.

Feronia elephantum, cultivated, and apparently wild.
Ægle Marmelos, cultivated and wild.
Cirtus medica, gardens.
C. decumana, gardens.
C. Limetta, gardens.
C. Bergamia, gardens.
C. Aurantium, gardens.

MALPIGHIACEÆ.

Hiptage madablota, gardens.
Aspidopteris nutans, jungle.

Sapindaceæ.

Cardiospermum Halicacabum, common.

Sapindus emarginatus, planted, rare.

Meliaceæ.

Melia composita, planted, rare.

Azidirechta indica, planted and wild (self-sown?).

Oxalideæ.

Oxalis corniculata, abundant.

Biophytum sensitivum, marshy soil.

Averrhoa Carambola, gardens.

Balsamineæ.

Impatieus hortensis, gardens.

Zygophyllaceæ.

Tribulus lanuginosus, common.

Balanites ægyptiacus, very common.

Simarubaceæ.

Ailanthus excelsa, not common, planted.

Ampelideæ.

Vitis erioclada, rocks.

V. indica, rocks.

V. carnosa, rocks and bushy places.

CALYCIFLORÆ.

Celastraceæ.

Celastrus asiaticus, on "kunker" soil.

Elæodendron Roxburghii, Kaliangurh, jungle.

Rhamnaceæ.

Zizyphus Jujuba, common.

Z. ——, var. hortensis, planted.

Z. nummularifolia, abundant.

Z. Œnoplia, common.

Z. Xylopyrum, hills.

Ventilago Madraspatana, hills, used to cure the itch.

Anacardiaceæ.

Mangifera indica, planted.

Odina Wodier, hills.

Buchanania latifolia, hills.

Semicarpus Anacardium, hills.

Boswellia glabra, hills.

Garuga piunata, hills, and planted.

Moringaceæ.

Moringa pterygosperma, planted.

Leguminosæ.

Heylandia latebrosa, rare.

Crotalaria mysorensis, rocks.

C. juncea, cultivated in fields.

C. retusa, rocky bed of Ken, &c.

C. sericea, gardens.

C. hirsuta, granite rocks.

C. medicaginea, dry pastures.

C. luxurians, abundant, favourite food of camels.

Rothia trifoliata, fields.

Psoralea corylifolia, black soil.

Medicago lupulina, bed of Ken.

M. dentieulata, fields.

Melilotus alba (*Lam.*), fields.

Trigonella polycerata, fields.

T. Fœnum-græcum, cultivated.

Clitoria Ternatea, gardens.

Indigofera linifolia, abundant.

I. cordifolia, abundant.

I. enneaphylla, abundant.

I. glandulosa, corn-fields, black soil.

I cærulea, ruins at Baragarh.

I. tinctoria, cultivated.

I. paucifolia, black soil.

I. trita, among rocks.

I. hirsuta, fields.

I. subulata (var. angulosa), Kurthal hill.

I. pulchella, abundant, hills, flowers eateu.

Tephrosia purpurea, abundant.

T. villosa, rare, Sehonda, &c.

T. diffusa, gravelly ground, Bauda.

Agati grandiflora, gardens.

Sesbania ægyptiaca, gardens.

S. spinulosa, fields, abundant.

Alysicarpus monilifer, common, barren ground.
A. vaginalis, common, grassy places and rocks.
A. nummularius, common, grassy places and rocks.
A. bupleurifolius, common, grassy places and rocks.
A. gracilis, Gurhrámpur, rocks.
A. longifolius, corn-fields.
A. Heyneanus, corn-fields.
A. scariosus (*Grah.*), waste ground.
A. tetragonolobus, waste ground.
A. rotundifolius, Kallinjer.
Alhagi Maurorum, sandy soil.
Æschynomene indica, ponds, &c.
Desmodium maculatum, groves.
D. diffusum, black soil.
D. triflorum, abundant.
Eleiotis sororia, rocky jungle.
Uraria picta, grassy places.
Zornia diphylla, sandy ground.
Cicer arietinum, cultivated in fields.
Ervum lens, cultivated in fields.
Vicia hirsuta, corn-fields.
V. sativa β angustifolia, moist places.
Lathyrus sativus, cultivated in fields.
L. sphæricus (*Retz.*), sandy corn-fields.
L. Aphaca, moist ground.
Pisum sativum, cultivated.
Abrus precatorius, common.
Galactia tenuiflora, bushy places.
Rhynchosia medicaginea, common.
Cantharosperma albicans, rocks.
Mucuna pruriens, rocks.
M. ——?, cultivated in gardens.
Phaseolus vulgaris, gardens.
P. Roxburghii, cultivated in fields.
P. aconitifolius, cultivated in fields.
P. setulosus, rocks, Patraha.
P. trilobus, black soil.
Vigna catajan, rocks.
Lablavia vulgaris, gardens.
Dolichos Lubia, cultivated in fields.
D. tomentosa, bushy places.
Canavalia gladiata, gardens.
Cajanus flavus, much cultivated.
Flemingia strobilifera, Brispatkund.
Erythrina stricta, Kurthal, gardens.
Dalbergia Sissu, common, planted.
D. latifolia, Rasoura.
D. paniculata, Raipur.
D. confertifolia, Bargturh.
Ougeinia dalbergioides, abundant, Patha.
Pterocarpus dalbergioides, Kaliangurh.
Pongamia glabra, planted.
Butea frondosa, common.
B. superba, Patha.

Mimoseæ.

Mimosa rubicaulis, not uncommon.
Desmanthus triqueter, black soil.
Dicrostachys cinerea, planted.
Pithecolobium dulce, planted, Durgapoor, from Deccan seed.
P. montanum, Kurthal hill.
Vachellia Farnesiana, gardens.
Acacia catechusoides, abundant, Patha.
A. Catechu, a single plant at Banda.
A. leucocephala, not common.
A. arabica, abundant.
Albizzia Lebec, common.
A. odoratissima, Lowri fort.

Cæsalpinieæ.

Poinciana pulcherrima, gardens.
Parkinsonia aculeata, planted.
Guilandina Bonduc, gardens.
Tamarindus indica, common, grow-to a vast size.
Cathartocarpus Fistula, gardens, and wild in Patha.
Cassia auriculata, rare.
C. Tora, rubble and fallows, abundant.
C. Abrus, rocky places.
C. pumila, rocky places.
C. Sophera, rubble.
Bauhinia variegata, planted, and spontaneous, Patha.

B. Vahlii, abundant, Patha and granite hills.

B. purpurea, Patha.

ROSACEÆ.

Rosa damascena, gardens.

R. indica, gardens.

Potentilla supina, moist ground.

COMBRETACEÆ.

Combretum nanum, Patha.

Terminalia Chebula, Patha.

T. Belerica, Patha and planted.

Pentaptera tomentosa, Patha.

P. Arjuna, Patha, rare in the plains.

Anageisseus latifolius, Patha.

A. angustifolia, Patha, and dwarfed on the granite hills.

GRANATEÆ.

Punica granatum, gardens.

ONAGRARIEÆ.

Jussiæa angustifolia, rare, mud banks.

Ludwigia parvifolia, mud banks.

Trapa natans, rare, ponds, Garêh.

LYTHRARIEÆ.

Lagerstrœmia indica, gardens.

L. parviflora, common on the sandstone, rare on the granite hills.

Grislea tomentosa, abundant.

Lawsonia inermis, gardens.

Ammannia indica, wet places.

A. glauca, wet places.

A. vesicatoria, wet places.

Ameletia rotundifolia, wet places.

A. tenuis, rocky streams.

ALANGIACEÆ.

Alangium decapetalum, most rare.

MYRTACEÆ.

Psidium pyriferum, gardens.

Eugenia Jambolana, planted, not common.

E. angustifolia, abundant in the Ken.

CUCURBITACEÆ.

Trichosanthes anguina, gardens.

T. palmata, rocks.

T. cucumerina, bushy places.

Momordica Charantia, gardens.

M. diœca, bushy places.

Coccinea indica, hedges, &c.

Luffa acutangula, gardens.

L. pentandra, gardens.

L. Bandaal, black soil.

Cucumis Madraspatanus, common.

C. utilissimus, gardens.

C. sativus, gardens.

C. Melo, sandy bed of Ken, planted.

Citrullus vulgaris, sandy bed of Ken.

C. Colocynthus, sandy bed of Ken, wild.

Benincasa cerifera, cultivated.

Mukia scabrella, very common.

M. laciniosa, bushy places.

Pilogyne Garcini, bushy places.

Lagenaria vulgaris, cultivated.

AIZOONEÆ.

Trianthema pentandra, common.

SAXIFRAGEÆ.

Vahlia viscosa, *Rox.*, wet places.

UMBELLIFERÆ.

Cnidium diffusum, rare.

Apium graveolens, garden.

Petroselinum sativum, garden.

Daucus Carota, garden.

Anethum Sowa, garden.

Ptychotis Coptica, garden.

Coriandrum sativum, garden.

LORANTHACEÆ.

Loranthus bicolor, Patha.

Viscum attenuatum, on *Zizyphus* Patha.

RUBIACEÆ.

Strephogyne parvifolia, Patha.

Nauclea cordifolia, Patha.

Randia dumetorum, common.

R. uliginosa, rare.

R. longispina, Patha.

Gardenia latifolia, Patha.

Hedyotis Burmanniana, abundant.

Morinda citrifolia, cultivated.
Ixora coccinea, gardens.
Spermacoce articulata, common.
Borrera lasiocarpa, rocks.

Compositæ.

Vernoniaceæ.

Vernonia cinerea, two var., common.
V. abbreviata.
V. aspera Patha.
V. divergens, Patha.
Elephantopus scaber, groves.

Eupatorieæ.

Adenostemma angustifolia, Gurhrámpur.

Astereæ.

Erigeron asteroides, rare.
Sphæranthus hirtus, bank of rivers.
Cyathoclina lyrata, ditto at Kallinjer, white-flowered.
Grangea Madraspatana, diito.
Blumea amplectens, ditto.
B. aurita, ditto.
B. oxyodonta, edges of fields.
B. eriantha, fallows.
B. lacera, banks of Ken.
B. Wightii, banks of Ken.
B. virens, the wet rocks (large); on stony dry places (small).
Pulicaria foliolosa, banks of Ken.
P. saxicola, dry rocks, Kurthal.
Francœuria crispa, sands of Jumna.
Vicoa indica, rocks and dry ground.
Cæsulia axillaris, wet places.
Eclipta prostrata, wet places, passim.
Blainevillia latifolia, rocks.
Siegesbeckia orientalis, rocks.

Senecionideæ.

Xanthium indicum, bed of Ken.
Sclerocarpus africanus, rocks.
Bidens Wallichii, rocks.
Glossogyne pinnatifida, dry ground.
Glossocardia Boswallia, dry ground.
Taygetes patula, gardens.
T. erecta, gardens.
Chrysanthellum indicum, dry ground.
Artemisia scoparia, fallow.
Pleurogyne cardiospermum, fallow, dried ponds.
Myriogyne minuta, damp places.
Filago indica, not rare.
F. crispatula, dry ground.
Emilia sonchifolia, rare.

Cynareæ.

Echinops echinata, Kallinjer.
Amberboa indica, black soil.
Microlonchus divaricatus, passim.
Cirsium arvense, sandy fields.

Cichoraceæ.

Cichoraceæ Endivia, cultivated.
Lactuca sativa, cultivated.
Brachyramphus sonchifolius, rocks and dry banks.
Microrhynchus asplenifolius, passim.

Campanulaceæ.

Campanula canescens, rocks.
Wahlenbergia dehiscens, fields.

COROLLIFLORÆ.

Primulaceæ.

Androsace rotundifolia, corn-fields.
Samolus Valerandi, wet places, rare.

Myrsinaceæ.

Ardisia humilis, banks of rocky rivers.

Ebenaceæ.

Diospyros embryopteris, Patha.
D. montana, Patha.
D. exsculpta, Patha.

Sapoteæ.

Bassia latifolia, abundant, wild and cultivated.
Mimusops Elengi, gardens.
M. indica?, wild, Patha, waterfalls.

Jasminaceæ.

Nyctanthes arbor tristis, cultivated and wild; some hills quite covered with it, *e.g.* Pangra.

Jasminum Zambac, gardens.
J. angustifolium, gardens.
J. odoratissimum, gardens.
J. grandiflorum, gardens.

Apocynaceæ.

Strychnos potatorum, Patha.
Carissa Corandas, gardens.
C. diffusa, passim.
Thevetia neriifolia, gardens.
Tabernæmontana coronaria, gardens.
Plumeria acuminata, gardens, very large ruins at Seonda.
Vinca pusilla, corn-fields.
Ichnocarpus frutescens, rocky jungles.
Vallaris dichotoma, rocky jungles.
Wrightia Rothii, rocky jungles.
Hollarhena pubescens, rocky jungle.
Nerium odorum, rocky streams, and gardens.

Asclepiadeæ.

Cryptostegia grandiflora, gardens.
Hemidesmus indicus, Patha.
Dæmia extensa, abundant, hedges.
Calotropis procera, abundant.
C. gigantea, rare, gardens.
Gymnema melicida, rocky hills.
Pergularia pallida, rocky hills.
? ?, rocky hills, sine flore et fructu.
Marsdenia tinctoria, granite hills (fruit very smooth).
M. tenacissima, granite hills.
Cyrtolepis Buchananiana, banks of Ken, Loretha.
Leptodenia reticulata, Rasaura jungle.
L. Spartium, arid bank of Jumna.
Cosmostigma, sp., Patha.
Ceropegia tuberosa, bushy places.

Gentianeæ.

Canscora diffusa, rocky hills.
C. decussata, rocky hills.
Slevogtia orientalis, not uncommon.
Pladera pusilla, rocks.
Exacum pedunculatum, damp ground.
Limnanthemum Kleinianum, ponds.

Bignoniaceæ.

Pajanellia multijuga, Patha.
Spathodea falcata, Patha.
Stenospermum suaveolens, rare.
Tecoma undulata, dwarfed, Chebou.
Millingtonia hortensis, gardens.
Schrebera swietenioides, Patha.

Sesameæ.

Sesamum orientale, cultivated.
Martynia biflora, run wild from gardens.
Pedalium murex, gardens.

Convolvulaceæ.

Evolvulus hirsutus, passim.
Convolvulus pluricaulis, passim.
C. Turpethum, jungles.
C. tridentatum, rocky hills.
C. arvensis, fields.
Ipomæa pilosus, jungles.
I. obscurus, hedges.
I. sessiliflorus, corn-fields.
I. reptans, ponds.
I. renifolia, marshy places, black soil.
I. sepiaria, hedges.
I. pes-tigridis, corn-fields.
I. pedata, gardens.
Pharbites Nil, gardens and hedges.
P. hispida, gardens.
Quamoclit vulgaris, gardens.
Q. phœnicia, gardens.
Batatas edulis, gardens.
B. pentaphyllus, hedges.
Anisæa calycina, hedges.
Calonyction muricatum, hedges.
Rivea, sp., Loretha (sine flore).
R. hypocraterimorpha, rare.
Porana paniculata, Patha.
Ericybe paniculata, Patha.
Cuscuta reflexa, abundant, especially on the Adhatoda.

Cordiaceæ.

Cordia Myxa, gardens.
C. obcordata, Patha.

Boragineæ.

Ehretia lævis, ravines.
E. (*Rhabdia*) viminea. in the river Ken.
Heliotropium brevifolium, common, barren ravines.
H. marifolium, near Budousa.
H. supinum, black soil.
H. europæum, cultivated ground, very common.
Arnebia hirsuta, ravines.
Trichodesma indicum, abundant.
T. Zeylanicum, rocky hills.
T. hirsutum, Kurthal.
T. amplexicaule, Banda.
Bothriospermium tenellum, banks of the Ken.

Hydroleaceæ.

Hydrolea Zeylanica, wet places.

Scrophularineæ.

Celsia Coromandeliana, banks of Ken, &c.
Linaria ramosissima, rocks.
Sutera glandulosa, black soil.
Stemodia viscosa, black soil.
Lindenbergia urticifolia, rocks.
Herpestes Monnieri, banks of rivers.
Ilysanthes parviflora, banks of rivers.
Bonnaya brachiata, shady places.
Sopuba delphiniifolia, black soil.
Striga euphrasioides, corn-fields.
S. hirsuta v. cærulea, rocks.
Limnophila gratioloides, rocky pools.
Buddleia Neemda, banks of streams.

Orobancheæ.

Philippæa indica, on *Sinapis* and corn.

Solanaceæ.

Datura Metel, cultivated.
Physalis somnifera, common, rubble.
P. angulata, rocks.
P. Peruviana, gardens.
Capsicum frutescens, cultivated.
Solanum melongena, cultivated.
S. indicum, rocky ground.
S. Jacquini, passim.
S. incertum, fields.
S. verbascifolium, Patha.

Acanthaceæ.

Elytraria cristata, gravelly soil.
Nelsonia tomentosa, moist places.
Ebermaiera pedicellata, Lawri fort.
Hemiadelphis polysperma, ditches.
Physichilus Serpyllum, banks of rocky streams.
Petalidium barlerioides, Kallinjer rock.
Dipteracanthus prostratus, shady places.
D. patulus, Buragurh fort.
Hemigraphis latebrosa, rocks.
Ruellia hirta, dry waste ground.
Barleria ciliata, rocky and raviny places.
B. prionitis, rocks at Rasin, and gardens.
Asteracanthus longifolius, ditches.
Lepidagathis ustulata, rocks.
L. cristata, ravines, common.
Blepharis molluginifolia, gravelly soil.
B. Boerhaavifolia, rocks.
Phlogacanthus thyrsiflorus, Patha.
Rostellularia rotundifolia, grass levels.
R. procumbens, rocky places.
R. peploides, fields.
R. quinquangularis, fields.
Adhatoda vasica, passim.
Eranthemum montanum, rocky hills.
Rungia repens, grassy places.
R. parviflora, rocks, larger than usual.
Peristrophe bicalyculata, passim, fields, &c.
Dicliptera cardiocarpa, banks.

Andrographis paniculata, rocky places.
A. echioides, rocky places.

VERBENACEÆ.

Lippia nodiflora, moist grounds, abundant.
Lantana alba, ravines.
Clerodendron phlomoides, ravines.
C. infortunatum, woods.
Gmelina parviflora, gardens.
Vitex bicolor, ravines.
Tectona grandis, a wood near Khundêh, and in Patha.

LABIATÆ.

Ocymum basilicum, gardens (three varieties).
O. sanctum, gardens.
Orthosiphon pallidus, rare, dry ground.
Anisochilus ovatus, waste ground.
Leonotis nepetifolia, gardens.
Leucas urticifolia, rocky grounds.
L. procumbens, rocks.
L. aspera, fields.
L. mollissima, Banda rock.

PLUMBAGINEÆ.

Plumbago Zeylanica, common.

SPHENOCLEACEÆ.

Sphenoclea Pongatium, marshes.

MONOCHLAMYDEÆ.

PHYTOLACEÆ.

Gisekia pharnaceoides, sandy ground.

SALSOLACEÆ.

Beta vulgaris ι. rubra, gardens.
B. vulgaris γ. orientalis, gardens.
Chenopodium album, gardens.

BASELLACEÆ.

Basella rubra, gardens.

AMARANTHACEÆ.

Celosia argentea, corn-fields.
C. cristata, gardens.
Amaranthus mangostanus, gardens.
A. paniculatus, gardens.
Euxolus caudatus, fields.
Ærua scandens, bushy places.
Æ. brachiata, moist shady places.
Digera arvensis, fields.
Pupalia lappacea, thickets.
Gomphrena globosa, gardens.
Alternanthera nodiflora, moist places.

NYCTAGINEÆ.

Boerhaavia diffusa, abundant.
B. repanda, thickets.
Mirabilis jalapa, gardens.

ARISTOLOCHIACEÆ.

Aristolochia bracteata, Banda, Chille Tara.

POLYGONACEÆ.

Polygonum barbatum, Gurhrámpur.
P. tomentosum, marshes.
P. Dryandri, dried mud.
Rumex dentatus, bed of Keu.

LAURINEÆ.

Cassytha filiformis, bushy places.

EUPHORBIACEÆ.

Emblica officinalis, gardens.
Phyllanthus simplex, fields, rocks.
P. madraspatanus, fields.
P. Niruri, cultivated ground.
Melanthesa Vitis Idæa, rocky thickets.
M. turbinata, gardens.
Anisonema multiflora, rocks, Kurthal.
Andrachne telephoides, banks of Ken.
Breidelia collina, jungles.
Crozophora plicata, abundant, black soil.
C. tinctoria, fields.
Baliospermum indicum, common.
Ricinus communis, cultivated, and wild?
Acalypha ciliata, rock.
Euphorbia nereifolia, gardens, &c.

E. rosea, black soil.
E. pilulifera, abundant.
E. parviflora, abundant.
E. indica, abundant.
E. granulata, banks of Ken.
E. Heyneana, passim.
E. serpens, passim.
E. dracunculoides, fields.
E. Rothiana, fields.
E. thymifolia, banks of ditches.
Rottlera tinctoria, jungles.
Adelia neriifolia, Ken river at Ramgurh.

Piperaceæ.

Piper Betel, cultivated, Seonda.
P., sp., damp rocks, Patha.

Ulmaceæ.

Ulmus integrifolia, passim.

Juglandaceæ.

Engelhardtia Colebrookii, Patha.

Urticaceæ.

Artocarpus Lakotha, gardens.
A. integrifolia, gardens.
Ficus carica, gardens.
F. indica, passim.
F. laccifera, Patha.
F. tomentosa, granite rocks, Banda.
F., sp.? *Gular*, cultivated.
F. religiosa, passim.
F. infectoria, rare, Chytara.
F. Ampelos, rocky hills, Chiterkot.
F. oppositifolia, rocky hills, waterfalls, &c.
F. heterophylla, bed of Ken, Ramgurh.
Epicarpurus aspera, not uncommon, very large at Nehi.
Pezolzoa hispida, sides of streams, Patha.

Salicineæ.

Salix tetrasperma, banks of Ken, Ramgurh.

Doubtful.

A climbing plant, called Pritbhanjan, and a tree called Rohin, of which I have no specimens remaining. The fruit and flowers unknown.

ENDOGENS.

Palmæ.

Phœnix sylvestris, rare.
Borassus flabelliformis, very rare, cultivated.

Pandaneæ.

Pandanus odoratissimus, rare, gardens.

Aroideæ.

Colocasia nymphæifolia, rare, Reonchi.
C. antiquorum, cultivated.

Lemnaceæ.

Lemna gibba, ponds.

Naiadaceæ.

Aponogeton monostachys, rare, pond at Goreh.
Zanichellia palustris, ponds.

Musaceæ.

Musa sapientum, gardens.

Cannaceæ.

Canna indica, gardens.

Zingiberaceæ.

Zingibar officinale, cultivated, not common.
Z. capitatum, jungles.
Curcuma longa, cultivated, rare.

Orchideæ.

Zeuxine sulcata, banks of brooks.
Dendrobium, sp., on trees, Patha, *sine flore*.

Iridaceæ.

Iris Persica, gardens.
Pardanthus Chinensis, gardens.

Hydrocharideæ.

Blyxa octandra, ponds.
Vallisneria spiralis, ponds.
V. alternifolia, ponds.
Hydrilla verticillata, ponds.

Amaryllideæ.

Agave Kanthala, gardens.
Pancratium Zeylanicum, gardens.
P. verecundum, gardens.
Crinum Zeylanicum, gardens.
C. toxicarium, marshes.
Narcissus Tazetta, gardens.

Liliaceæ.

Polyanthus tuberosa, gardens.
Aloe indica, gardens.
Yucca gloriosa, gardens.
Allium sativum, gardens.
A. Cepa, gardens.
Asphodelus clavatus, corn-fields.
Hemerocallis, sp., gardens.
Asparagus officinalis, gardens.
Gloriosa superba, jungles.

Dioscoreaceæ.

Dioscorea alata, cultivated.
D. sagittata, rocks.
D. pentaphylla, jungles.

Juncaceæ.

Juncus dichotomus, marshes.

Alismaceæ.

Sagittaria sagittata, ponds.
S. cordata, ponds.

Commelynaceæ.

Commelyna Bengalensis, rubble.
C. salicifolia, rubble.
C. gelatinosa, rocks.
Cyanotis axillaris, marshy ground.
C. imbricata, marshy ground.
Aneilema nanum, waste places.
A. nudiflorum, grassy places.

Eriocauloneæ.

Eriocaulon sexangulare, moist ground.

Cyperaceæ.

Cyperus compressus, sandy ground.
C. niveus, abundant.
C. aristatus, sandy ground.
C. rotundus, too abundant.
C. Iria, rice-fields.
C. pygmæa, springs, Ken.
C. auricomus, wet ground.
Isolepis Roylei, wet ground.
I. barbata, sandy ground.
Scirpus affinis, wet ground.
Malacochæte pectinata, wet ground.
Elæocharis palustris, marshes.

Graminaceæ.

Paniceæ.

Paspalum scrobiculatum, cultivated.
P. longifolium, marshes.
P. brevifolium, *Flug*, shady places.
P. pedicellatum, sandy fields.
Helopus annulatus, fields.
Coridochloa cimicina, fields.
Digitaria commutata, fields.
D. sanguinolenta, fields.
D. cruciata, fields.
D. appressa, fields.
Panicum flavidum, common.
P. colonum, abundant.
P. eruciforme, *Sib.*, poor soil.
P. prostratum, *Lam.*, fields.
P. nudiglume, fields.
P. angustatum, rock.
P. Petiverii, fields.
P. vestitum, fields.
P. Helopus, fields.
P. triflorum, rocks.
P. frumentaceum, cultivated.
P. crux-galli, ditches, &c.
P. antidotale, thickets.
P. maximum, cultivated, gardens.
P. paludosum, ponds.
P. humile, fields.
P. miliare, cultivated in Patha.
P. miliaceum, cultivated, *passim.*
Echinochloa stagnina, wet places.
Orthopogon Burmanni, under trees.
Setaria helvola, *passim.*
S. italica, cultivated.
S. Rottlera, shady places.
S. verticillata, common.
Penicillaria spicata, cultivated.
Pennisetum holcoideum, rocky jungles, Gurrampur.

P. barbatum, rocky jungles, Banda.
Gymnothrix hordeoides, rocky jungles, Gurrampur.
Cenchrus echinoides, sandy moist ground.
C. montanus, sandy moist ground.
Lappago biflorus, sandy moist ground.

Agrostideæ.

Polypogon crinitus, moist places.
Sporobolus Lindleyi, fields.
S. Coromandelianus, fields.

Arundineæ.

Arundo karka, hedges, &c.
Thysanalæna Agrostis, rocks.

Andropogoneæ.

Perotis latifolia, sandy ground.
Imperata Kœnigii, damp ground.
Saccharum Sara, near Jumna.
S. spontaneum, *passim*, the curse of the country.
S. officinale, cultivated.
Leucæa gracilis, Banda rocks.
Bathropogon echinatus, Banda rocks.
Anatherum muricatum, inundated ground.
Sorghum vulgare, cultivated.
S. Halepense, thickets, &c.
Raphis cæruleus, rocks.
R. montanus, rocky woods.
R. serrulatus, Patha.
Andropogon tenellus, poor gravelly soil.
A. Bladhii, pastures.
A. annulatus, thickets.
A. pertusus, pastures.
A. orthos, pastures.
A. Ischæmum, rocky jungles.
A. (*Cymbopogon*) pumilus, pastures.
A. Martini (*Nardoides*, Nees), rare pastures, Patha.
A. Schœnanthus, gardens.
Heteropogon contortus, pastures, abundant.
Anthistiria, sp. (*Musel*), pastures, the best hay.
A. arguens, pastures, coarse hay.
Iseilema arguntum, marshes.
I. prostratum, moist pastures.
Apluda aristata, thickets.

Stipeæ.

Aristida vulgaris, pastures.
A. Royleana (*murina*, Nees), pastures.
A. capillacea, pastures.

Olyreæ.

Coix gigantea, marshes.
C. barbata, rocky thickets.
Zea Mays, cultivated.

Chlorideæ.

Chloris decora, pastures.
Gymnopogon digitatus, thickets.
Eleusine coracana, cultivated.
Leptochloa filiformis, shady places.
L. retroflexa, black soil.
L. trigonoides, Sehonde.
Dactyloctenium Ægyptiacum, waste places.
Cynodon Dactylon, abundant.
Acrachne verticillata, ploughed land.
Schœnfeldia pallida, dry ground.
Melanocenchris monœca, dry ground.

Hordeæ.

Hordeum hexastachyon, cultivated.
Triticum æstivum, cultivated.

Rottbœlleæ.

Meorchium rugosum, black soil.
Mnesithea lævis, moist pasture.
Hemarthia fasciculata, moist pasture.
Ophiurus corymbosus, black soil.
Rottbœllia exaltata, edges of rich fields.
Manisurus granulatus, rocks or gravelly ground.
Oropetium Thomæa, rocks or gravelly ground.

Poeæ.

Poa annua, walks, fields, &c.

Eragrostis bifaria, rocks.
E. plumosa, fields.
E. verticillata, fields.
E. diandra, fields.
E. unioloides, fields.
E. nutans, black soil.
E. viscosa, edges of ponds.
E. megastachya, fields, common.
E. poëoides, fields, common.
E. Brownii, edges of ponds.
E. cynosuroides, low ground, common.
Elytrophorus articulatus, ponds, rice-fields.

Bambuseæ.

Bambusa stricta, rocky hills.

Oryzeæ.

Oryza sativa, cultivated.
Leersia aristata, ponds.

ACROGENS.

RHIZOSPERMEÆ.

Marsilia quadrifoliata, ponds and ditches.

EQUISETACEÆ.

Equisetum debile, fields.

CHARACEÆ.

Chara verticillata, streams.

SALVINIACEÆ.

Azolla, sp., ponds and streams.

LYCOPODIACEÆ.

Selaginella imbricata, Patha.

POLYPODIACEÆ.

Polypodium proliferum, wet rocks, Patha.
Nephrodium unitum, wet rocks, Patha.
Pteris amplectens, wet rocks, Patha.
P. radiata, dry rocks and walls.
Adiantum vestitum, dry rocks and walls.
A. Capillus-Veneris, walls and wet rocks.
Cheilanthes dealbata, dry rocks.

BRYACEÆ.

Hypnum, sp., wet rocks, Patha.
Phascum, sp., damp earth, common.

NOTES.

The question of the foreign origin of the custard-apple admits of but little doubt on my mind. Those who argue in favour of its being indigenous quote the native name Sítaphal, and the tradition that it was upon it that Síta supported herself during her long wanderings in the forests in Bundelkund. And they state that it is met wild in many parts of the jungle of central India.

It is certainly found in great abundance on certain hills in Bundelkund; but on no hills is it found on which there are not large forts, *e.g.* Marfa, Kallinjer and Ajigarh. I have never seen a bush of it on any other, not even those next adjoining, and from all the inquiries I have made among the natives I gather that it is not found in any other locality.

The only place which has been specifically mentioned to me as a habitat is the hill of Asirgarh, likewise crowned by a fort. I see therefore no reason to doubt that it has run wild on these hills from gardens inside the fort. The large seeds dropped by birds, monkeys, or bears would readily germinate; the only mat-

ter for surprise is, that it has not been more widely diffused. I do not admit the closeness of the resemblance of the fruit described by Capt. Abbott, in vol. xvi. J. A. S., p. 666, to the custard apple. It might as well represent a Jack fruit—but is rather, I imagine, a fancy composition than an imitation of any real fruit.

Alysicarpus tetragonolobus. Procumbens, a basi ramosus, ramis teretibus *linea pilosa* notatis, foliis breviter petiolatis ovatis oblongisve obtusis, supremis angustioribus basi subcordatis supra glabris subtus strigosis stipulis basi latis subcordatis cuneatis acutis ciliatis petiolo longioribus, racemis laxis terminalibus oppositifoliisque, bracteis late ovatis acutis striatis puberulis ciliolatis, præ anthesi caducis, bifloris, rachi pedicellisque puberulis, calyce 4-fido segmento superiore bifido, omnibus acutis puberulis longe pilis albis ciliatis in fructu approximato-imbricatis, articulum secundum superantibus; leguminibus 4–8-articulatis, inter articulos valde contractis subarcuatis articulis plus minus obliquis, inæqualiter *quadrangularibus* angulis costatis, lateribus valde reticulato-rugosis puberulis, infimo stipitiformi et supremo mucronato sterilibus.

This much resembles in habit *A. monilifer* and *A. styracifolius*, and like them grows in barren grassy places, but is easily distinguished by the line of hairs on the stem and the 4-angled legume. Its flowers open about noon, and close at 2 or 3 P.M.

A. gracilis. Erecta glabra ramosa, ramis teretibus, stipulis scariosis acuminatis subvaginantibus petiolo longioribus, foliis unifoliolatis pedicello caudiculatis, stipellis minutis punctiformibus, foliolo anguste elliptico basi subcordato apice mucronato, supra glabro, subtus pallido, parce piloso, racemis axillaribus terminalibusque, bracteis caducis 2-floris, calyce 4-fido segmentis ciliolatis, superiore breviter bidentato nec bifido, vix imbricatis, legumine calyce plus duplo longiore 3–5-articulato moniliformi articulo supremo mucroniformi puberulo, ceteris obliquis valde contractis subcompressis glabris vix reticulatis.

This differs much in habit from all the other species I know; very slender, about 2 feet high, growing on shady rocks at Gurhrampúr.

In the Kew Herbarium it has been referred to *A. bupleurifolius*; but the habit is very different, and there is technical difference in the calyx.

Luffa Bandaal. I have little doubt that this is Roxburgh's species, which was sent to him from Cawnpore, and is called Bandál by the natives; but his description is imperfect and somewhat incorrect. I have never seen the plant climbing, and the echini of the fruit are not ciliate, while the leaves are uniformly 5-lobed; however, the leaves of all cucurbits vary so much that they are

not a character at all to be relied on; should it be a different species it should be called *L. longistyla.* The following is the detailed description.

Dioica, diffusa, ramis subglabris scabriusculis, foliis longe petiolatis 5-lobis, lobo medio longiore acuto plus minus sinuato-lobato, ceteris acutis vel obtusis denticulatis, utrinque scabris glabris, cirrhis bifidis, pedunculis geminis axillaribus uno longissimo 1-floro, altero racemoso multifloro, bractea parva ovata, pedicellis gracilibus, calyce 5-fido rotato, corolla rotata 5-fida tenui alba, segmentis obtusis extus parce pilosis, staminibus 5 triadelphis; ♀ pedunculis solitariis unifloris petiolo (adulto) brevioribus, calyce villoso, limbi laciniis 5 acutis, corolla subrotata ut in ♂, stylo longo apice 3-fido, stigm. 3 bifidis, peponide ovato v. subgloboso echinato, echinis glabris, apice stylo persistente, increscente apiculato.

The fruit is bitter, and is sold in the bazaars as a horse-medicine. It grows abundantly on marshy land at the commencement of the rains; the flowers open in the morning, and close before 10 A. M. They are pure white, and very delicate in texture.

Adenostemma angustifolia. Foliis lineari-lanceolatis utrinque acuminatis longe petiolatis serrulatis, corymbis oligocephalis, acheniis lævibus glandulis pedicellatis coronatis.

My specimens were gathered very late in the season. I could find but a single flower, and therefore cannot now give a more detailed description.

Pulicaria saxicola. Decumbens, ramis divaricatis incanisve, demum glabratis foliosis apice 1-cephalis, foliis omnibus sessilibus angustis oblongis ramo subadpressis integris vel remote denticulatis obtusis apice calloso-mucronulatis utrinque plus minus sericeo-pubescentibus, involucri squamis exterioribus arachnoideo-lanosis oblongis *latiusculis* apice subiter attenuato liberis, junioribus foliaceis demum sphacelatis, infimis infra glabriusculis, sursum pilosis subiter cuspidatis, fl. radii ligula 3-nervia, styli ramis longis apice acumine appendiculatis, fl. disci 5-meris margine incrassatis, antherarum caudis latiusculis basi sublaceris, styli ramis brevibus lanceolatis post anthesin caducis, pappo exteriore coroniformi lacero vel ciliato-dentato, inferiore 10-setoso setis apice barbellatis subplumosis, achenio subtereti compressiusculo lineis 5 pilosis instructo, receptaculo alveolato parce piloso.

Grows on the rocks or gravelly débris of the granite hills, as at Sehonda, Kurthal. The solitary loug-peduncled heads, sessile not stem-clasping leaves, and the pappus distinguish it readily from all the species in D.C.

Gymnema melicida. The only decided character by which I can distinguish this from *G. sylvestris* is that the squamulæ of the

corolla are *acute* and *cover* the gynostegium, not obtuse and shorter as described by Decaisne. The leaves are more lanceolate and more sharply pointed than in the specimens of *G. sylvestris* that I have seen.

I have given the name from the peculiar quality of the leaves. A leaf chewed in the mouth deprived it of all power of tasting anything sweet for many hours afterwards.

TRICHODESMA HIRSUTA. Erecta, ramosa, hirsuta, ramis 4-angularibus sulcatis, foliis caulinis oppositis sessilibus ovato-lanceolatis scabro-hirsutis floralibus oblongis alternis subamplexicaulibus, pedicellis nutantibus calycibusque hirsutis, sepalis basi longe sagittatis acuminatissimis in fructu apertis (nec clausis ut in *indica*), corollæ cæruleæ segmentis rotundatis apice subito in caudulam productis, nuculis lævibus.

This differs from *T. indica* in habit and pubescence, and in the shape of the leaves; the horns of the calyx are much longer than in *T. spinulosa*.

RHABDIA VIMINEA. Suffrutex glaberrimus, ramis virgatis teretibus, foliis subalternis v. irregulariter dispositis crebris crassiusculis obovatis spathulatisve subsessilibus mucronatis glaberrimis margine tantum pilis paucis adpresse strigosis, floribus vel solitariis vel in cymis subdichotomis in apice ramulorum dispositis, calyce 5-partito segmentis anguste ovatis acuminatis quincuncialibus strigose ciliatis, corolla campanulata 5-fida æstivatione 5-unciali glabra, staminibus 5 basi corollæ ortis, inclusis, filamentis latiusculis subito attenuatis, antheris terminalibus basi fixis sagittatis rima laterali dehiscentibus, polline elliptico, ovario biloculari glabro ovulis 4 pendulis, stylo bifido, stigmatibus capitatis; bacca 4-sperma succo aqueo fulvo, dissepimento evanido, seminibus 2–3 sæpe abortivis, testa dura, embryo leviter curvato in medio albuminis tenuis sito, cotyledonibus planis crassiusculis obovatis.

This shrub is very peculiar in its habit, growing upon granite rocks in the bed of the river often submerged for weeks, its long branches hanging down into the water when the rocks are left exposed. These branches are so flexible and tough, that they may be tied in a knot without breaking.

I have entered fully into the description, as there is some doubt in my mind whether this should not be referred to *Ehretia*, or whether, with another very similar species which differs in having silky pubescence, found by Major Madden in the same sort of position on rocks in the Kali Ganga in Kemaon, which I propose calling *R. sericea*, it should not be considered to belong to the South American genus *Rhabdia*.

The differences between the two genera appear to consist first in the æstivation of the calyx, secondly in the shape of the corolla, thirdly in the proportionate length of the stamina and corolla, fourthly in the insertion of the stamina, fifthly in the position of the anther on the filament, sixthly the style whether bifid or simple, seventhly the nature of the berry, eighthly the nature of the albumen, and ninthly the shape of the embryo. In the first, second, third, fourth, fifth, and seventh points, it is a *Rhabdia*; but in the sixth its bifid style, in the eighth its thin scarcely fleshy albumen, and in the ninth the slightly curved embryo would make it rather an *Ehretia*. I think the preponderance of characters, added to the habit give the verdict in favour of *Rhabdia*.

Ebermaiera pedicellata. Glabriuscula partibus junioribus lanato-puberulis, foliis ovatis oblongisve in petiolum attenuatis obtusis integris, fl. ternis axillaribus pedicellatis, bracteis anguste ovatis basi attenuatis calycisque laciniis glanduloso-ciliatis, corollæ fauce filamentisque pilis parvis rubris instructis, antherarum loculis mucronatis, minorum discretis.

Found in the inside of the ancient fort of Louri.

Commelina gelatinosa. Caulibus ramosis semiteretibus uno latere plano scabro pubescente, foliis oblongo-lanceolatis acuminatis subinæqualibus subtus glaucis minute puberulis supra scabris breviter petiolatis vaginis striatis margine fisso ciliatis fauce barbatis, spathis falcatis acutis turbinato-cucullatis uni- rarius bipedicelliferis, pedicellis ambobus floriferis, capsulâ 3-loculari 3-sperma striata.

Rocks at Banda.

Caules ramosi geniculati diffusi subascendentes; vaginæ breves striatæ scabriusculæ margine ciliatæ ore barbatæ; folia oblongo-linearia 4–5-pollicaria. Spathæ terminales subcorymbosæ pedunculatæ bracteis hyalinis ovatis pedunculum intra vaginam amplectentibus, falcatæ acutæ turbinato-cucullatæ striatæ parce pilosæ succo gelatinoso plenæ. Pedicelli singuli inclusi, ramis gemini (altero exserto) 3–4-flori quorum plerumque unus tantum fructifer; sepala 3 hyalina, superum ovatum acutum erectum, 2 concava, obtuse deflexa prope apicem in unum coalita, cyathum emarginatum formantia. Petala 2 longe unguiculata, limbo orbiculato, pallide cærulea, tertium minimum hyalinum ellipticum acutum; stamina 3, duorum antheris ovatis cæruleis, tertii flava (valvis nigrescentibus) late sagittata basi deformata, dorso glandulosa, Parantheræ cruciatæ glanduliferæ. Stylus in alabastro circinatim, defloratione spiraliter tortus. Capsula 3-loba, 3-sperma, tenuiter striata, in spatha nidulans; semina majuscula nigra non lucida.

This comes nearest to *C. Donii*, *striata*, and *angustifolia*, but is immediately distinguishable from them by the scabrous upper

surface of the leaves, as well as other points. The spathes are generally filled with a clear gelatinous substance. This agrees with *Thwaites* 3224 from Ceylon in the Kew herbarium, under the name *longifolia.*

Panicum triflorum. Annuum, repens, molliter pubescens, culmis decumbentibus semiteretibus pubescentibus, vaginis laxis, ligula breviciliata, foliis oblongo-linearibus basi subcordatis apice breviter acuminatis quandoque latiusculis, panicula pauce ramosa tomentosa, racemis rectis subalternis divergentibus, rachi et rachilla excavatis dorso tomentoso angulis scabris, pedicellis pilosis setis paucis fulcratis, locustis 3, 2 vel 1 subsessili late ovatis acutis, trifloris (rarius 2-); glumis 2, exteriore subdecurrente subhyalina obscure 3-nervia ceteras basi arcte amplectente, interiore late ovata 5-nervia, floribus 3 (v. 2), quorum 2 (v. 1) neutris, 1 ♂ flore inter neutros, fl. neutro inferiore 1- rarius 2-paleato palea exteriore 5-nervia acuta, interiore hyalina alterius floris neutri palea exteriore duriore concava 5-nervia apiculata, interiore hyalina oblonga margine involute bidentato, floris fertilis paleis rugosis, exteriore concava 3-nervia, nervis prominentibus glabris, acutiusculâ interiore isti inclusâ, marginibus involutis subauriculatis, lodiculis majusculis, dolabriformibus crenulatis, staminibus 3, antheris vix exsertis fuscis, stylis 2 a basi divergentibus, stigmatibus ramoso-plumosis, semine hinc compresso.

Among rocks at Banda; I formerly found it at Rudour in fields, in the Sikh states; the number of florets at once distinguishes it from the whole genus.

Schœnfeldia pallida. Annua, ramosa, glabra, vaginis margine ciliolatis ligula ciliato-membranacea, foliis linearibus hinc illinc pilis perpaucis sparsis demum convolutis, spicis geminis (raro solitariis ternisve) secundis confertifloris ($2\frac{1}{2}$–3-uncialibus), rachis margine serrulato, locustis 1-floris sessilibus bifariis; glumis 2 persistentibus acute carinatis nervo medio sulcatis, apice in setulam productis, in priore majore paleis plus duplo longiore, flore in callo sericeo stipitato bipaleaceo, palea exteriore majore alteram plane enervem involvente extus puberula sub apicem fissum aristam longissimam hispidam gerente, lodiculis glabris carnosis apice emarginatis, stam. 3, anth. flavis, ovario fusiformi, stylis basi approximatis apice plumoso paullo exsertis, semine longo subfusiformi magno cæruleo.

The only described species of this genus is a native of Senegal. Having seen only the gen. char. in Endlicher, I know not how far this may differ specifically. It may be the same. This plant grows pretty abundantly on barren kunkury ground, old roads, &c.; at Banda it has a very peculiar light straw-colour.

Note on the Structure of *Medicago sativa*, as apparently affording facilities for the intercrossing of distinct flowers. By the Rev. George Henslow, M.A., F.L.S.

[Read November 16, 1865.]

In the flowers of this plant, the vexillum is inserted by a short claw, and is so folded as to leave a depression inside along the medial line. The alæ have slender claws, there being on the inside face of the limb of each petal a tooth-like process projecting forwards, and which is also produced backwards parallel to the claw. These latter backward extensions of the processes converge over the stamens, and pressing on the staminal tube confine it in its position. The petals of the carina present each a depression, which receives the process projecting forward on the inner face of the corresponding alary petal. The carinal petals cohere, and include the extremity of the staminal tube and pistil, together with the anthers.

The walls of the staminal tube are remarkably thick, its tissues being distended with fluid. The tissues become gradually thinner towards the edges of the fissure on the upper surface. The cells are of about the same shape and dimensions on both surfaces, being more or less oblong and united by oblique ends. The average length is ·00344 to ·0046 inch, and breadth ·00115 inch. Nine small bundles of spiral vessels pass into the extremities of the free portions of the filaments.

The tube is at first horizontal, the extremity being concealed within the adpressed petals of the alæ and carina; but if any object, as a pin, be directed down the channel formed by the vexillum, its point will be conducted into the small elliptical space between the alæ, and immediately in front of the backward extensions of the tooth-like processes. On pushing the pin further, it can scarcely avoid pressing against these processes in a lateral direction; the consequence is, that the tube is instantly released, and springing upwards strikes violently the vexillum, and dashes the pollen both against it and upon the pin, and then assumes a vertical position and a rigidly curved form.

The tenth or free stamen appears to have no independent elasticity, but is simply forced upwards and bent by the action of the coherent filaments. Having once become curved, it is impossible to straighten the tube so as to make it assume its original position, without causing a transverse fracture.

I have not been able to discover whether the curvature is caused

by distention of the cells on the convex side or a corresponding emptying of those on the concave, as no apparent difference could be detected either in the relative size of the cells or in the amount of moisture they relatively contained; for they all presented a similar appearance: but it is possible to examine them only after the tube has become curved; for the moment it is liberated from the petals, it instantly assumes that form. Possibly some such arrangement as the above may exist while it is in the horizontal condition, thereby retaining a state of unstable equilibrium, which is instantly destroyed by the process of erection and curvature.

The erection of the staminal tube is quite independent of the pistil, which may be severed from the receptacle without any displacement of the stamens by passing a scalpel through the enlarged orifice at the base of the slit on the upperside. On the other hand, if the pistil be subsequently removed, *i. e.* after the stamens are freed, it will be found to exhibit no elasticity or even tendency to become curved. Simultaneously with the erection of the stamens, and in consequence of the superior processes of the alæ being displaced, the alæ and carina immediately drop down, firmly locked together, and give that peculiar "gaping" appearance not uncommon amongst papilionaceous corollas. The petals of the carina also possess a strong inherent tendency to diverge and to become horizontal. This tendency seems to aid considerably the uprising of the stamens.

With regard to hive-bees sucking the nectar from the flowers of *Medicago sativa*, they were frequently visited by them, but in no instance could I find that they had power enough to set free the staminal tube. No opportunity of observing humblebees presented itself.

The peculiar property of the ejection of the stamens is common to all other species of *Medicago* that I have observed.

The natural inference that one would draw from the above-described structure of the stamens is, that it is in some way purposed to secure the intercrossing of distinct flowers; and observations made by Mr. Darwin on *Medicago lupulina** would seem

* Note on *Medicago lupulina*, communicated by Mr. Darwin:—

"I covered a number of plants with a net (which I know does not injure their seeding), and left others close by uncovered, and these were visited incessantly by bees. I could not compare their relative fertility with accuracy, on account of the easy shedding of the seed; but I gathered 150 not quite ripe pods of both; those from under the net weighed 77 grains, and those visited by the bees weighed 101 grains. No doubt the difference in the weight of the seed would have been considerably greater, as the pod is formed independently of the number of seeds."

to favour this supposition. But while this would seem to be effected by the stamens springing up in *Medicago*, as also in *Genista* and *Cytisus* (though in these two and, perhaps, other instances there appears to be no curvature of the staminal tube), the more general way would seem to be by the depression of the carina with or without that of the alæ. This has been already observed by Mr. Darwin and others in *Trifolium*, *Lupinus*, *Phaseolus*, &c., and by the present writer in *Onobrychis*, *Lotus*, *Lathyrus*, &c.

Hypothetical Origin of Diadelphous Stamens.—It would seem probable that the diadelphous condition of the stamens, and the fact that the sheath gapes at its base, favour the uprising of the bundle. Had the stamens been monadelphous, their future condition would be apparently more or less impeded by the corrugations on the upperside which would, on that hypothesis, have presented themselves. If the above idea be worthy of consideration, might not the diadelphous condition of other species, whose stamens have no power of erection, be regarded as instances of the retention of a particular structure whose function is in abeyance? while the greater degree of integration presented by the monadelphous species would seem to point to a further advance in structure by the complete fusion of the upper stamen with the anterior nine, so that those species which have diadelphous stamens would be in a transition state between entire freedom or differentiation (as in *Cercis siliquastrum*) and complete integration (as in *Ulex*, *Genista*, &c.).

Note on the Existence of the true *Cyperus Papyrus*, L., in Palestine. By the Rev. H. B. Tristram, M.A., F.L.S.

[Read March 1, 1866.]

During my travels in Palestine in 1864, I was pleased to find a Papyrus growing luxuriantly by the shores of the Lake of Galilee, close to the Ain et Tîn, on the north of the plain of Gennesaret. Some stems which I measured exceeded 16 feet in length.

I afterwards found in the almost inaccessible marshes of the Huleh (the ancient Merom) many acres of the same plant. It is noticed by Dr. Thomson in his 'Land and Book,' who gives a fair popular description of the plant under its familiar Arabic name of "*Babeer*," but without knowing that the classical and

modern "*Papyrus*" is simply a form of the original "*Babeer*" (ببير). The stems are cut down by the Bedouins for a less noble purpose than they served under the fostering care of the Pharaohs, viz. for the thatching of their huts and roofs, and for mats; and the roots are collected for fuel.

I preserved, unfortunately, but one specimen from the Lake of Galilee; and none from Merom. Since the *Papyrus syriacus* is well known as growing on the plains of Acre and Sharon, I was assured that this must be the same. Feeling, however, some suspicion on the subject, I forwarded my specimen to Professor C. C. Babington, of Cambridge, who assures me that he has no doubt of its being the true *Cyperus Papyrus*, and not the plant usually cultivated under that name, which is the *Cyperus syriacus* of Parlatore, who has published an excellent paper on the two plants in the 'Mémoires par divers Savants Etrangers,' vol. xii., Institut de Paris, with plates.

I regret that at the time of my visit the seeds were not ripe, as Prof. Babington informs me that no living specimen of the true *Cyperus Papyrus* exists in our botanical gardens.

He also adds that it is only known now to grow in marshes of the White Nile in Nubia, 7° north, but is lost in Egypt, and that my discovery, though simply a corroboration of the statement of Bruce (Travels, vol. vii. p. 115), may be of some interest.

It appears to me that the discovery of this species so far north as the upper end of the Lake of Galilee is important when viewed in connexion with our discovery of so many African species of fish in that Lake—the more so as the ornithological and mammalian forms which recall the African fauna do not extend so far up the Jordan basin, and it was to the south of the Dead Sea that we obtained most of our African types, as shown by Mr. Lowne in his paper (*suprà*, p. 201) on the flora of the Wady Zuweirah.

I may add that I have taken measures to secure some of the seed being collected this year for transmission to Dr. Hooker and Prof. Babington.

Memorandum on the Genus *Thamnea*, Solander, and other Bruniaceæ contained in the South African Herbarium of the late Dr. Burchell, F.L.S. By Professor OLIVER, F.R.S., F.L.S., Keeper of the Kew Herbarium.

[Read March 1, 1866.]

IN the Cape collections of the late Dr. Burchell there are numerous specimens of four species of the curious and little-known genus *Thamnea*, Solander, including specimens of the only species hitherto described—*T. uniflora*. *Thamnea* was first made known by M. Brongniart in 1826 (Ann. Sc. Naturelles, sér. 1. t. viii. p. 386). In his remarks upon it he called attention to the remarkable structure of its ovary, which he described as unilocular, with a slender central column, enlarged at the apex into a disciform placenta, round which are suspended, apparently, ten ovules. This unilocular condition he rightly ascribed to the "*destruction des cloisons des loges*;" and from the (apparent) number of ovules he inferred that the ovary was probably normally 5-celled, each cell being biovulate, the number of ovules in each cell of the ovary in other genera of Bruniaceæ never exceeding two.

Dr. Burchell's specimens enable me to ascertain satisfactorily that *Thamnea* is dicarpellary *. In two of the species (*T. depressa* and *T. hirtella*) the ovary is either wholly bilocular at the time of flowering, or nearly so. In *T. uniflora* I find two distinct opposite ridges on either side of the central column upon the underside of the plane top of the ovary, indicating the suppressed dissepiment. In *T. gracilis*, on the other hand, there is a similar ridge upon but one side of the ovarian cavity, and certainly no trace of it on the opposite side. How to explain such a condition in the absence of any obliquity in the flower indicating it to be monocarpellary I cannot tell. In none of the species do the ovules appear to exceed four to each cell; in two species they are geminate. All the species agree in their solitary terminal flowers (sometimes however upon very short lateral ramuli), in their wholly inferior plane-topped turbinate ovary, elongate simple style, and (in three of the species) one-seeded fruit. The species of *Thamnea* may be described as follows:—

Ovula 8 (in utroque loculo 4).

1. T. UNIFLORA, *Sol., Brongn. in Ann. Sc. Nat.* sér. 1. t. viii. **Erecta, glaberrima, ramulis strictis, foliis arcte adpressis imbricatis lanceolatis**

* Dr. Sonder, in 'Flora Capensis,' ii. 324, says 1- (or 5–2-) celled.

trigonis obtusiusculis, involucralibus tennioribus conformibus nucem monospermam turbinato-ellipsoideam leviter sulcatam excedentibus, ovario uniloculari (dissepimento incompleto vel subnullo).

Cape of Good Hope, *Masson*! *in Hb. Mus. Brit. et Benth.*; Hottentot-Holland Kloof, *Burchell*! *in Herb. Kew.* (no. 8274).

I find only 4 ovules to each carpel, as stated in Messrs. Bentham and Hooker's Genera Plantarum (i. 671), not 5 (10 altogether) as described, though with some hesitation, by M. Brongniart. The two outer of each four are very early arrested. The fruit is one-seeded. The inner wall of the pericarp shows two opposite lines or ridges, indicating the position of the dissepiments, which become wholly or in great part reabsorbed.

2. T. HIRTELLA, sp. nova. Decumbens, ramulis floriferis adscendentibus fastigiatis sparsim pilosulis, foliis lanceolatis trigonis obtusis imbricatis laxe adpressis, involucralibus lineari-lanceolatis pilosis ciliatisve apice subpatentibus recurvisve, ovario biloculari (vel dissepimento interdum imperfecto).

Cape: on Witsenberg, near Tulbagh, *Burchell*! *in Herb. Kew.* (no. 8685).

Fruticulus with procumbent primary branches throwing up numerous flowering ramuli, attaining probably from 4–8 in. to 1–2 ft. in height.

Ovula 4 (vel in utroque loculo 2).

3. T. DEPRESSA, sp. nov. Procumbens, glabra, ramulis floriferis brevibus numerosis adscendentibus subfastigiatis, foliis minutis adpressis imbricatis ovatis deltoideisve trigonis obtusiusculis, involucralibus conformibus nuce ellipsoideo-truncata leviter sulcata paulo brevioribus, ovario imperfecte biloculari, ovulis geminatis.

Cape: Baviaan's Kloof, Genádendal, *Burchell*! *in Hb. Kew.* (no. 7678).

A low intricately branched shrub of 6–9 inches.

4. T. GRACILIS, sp. nov. Erecta vel diffusa, glabra, ramulis gracilibus dichotomis strictiusculis, foliis arcte adpressis imbricatis lanceolatis trigonis obtusiusculis, involucralibus exterioribus ovatis, interioribus lanceolatis, nuce monosperma profunde sulcata brevioribus v. æquilongis, ovario uniloculari 4-ovulato.

Cape: summit of Craggy Peak, near Zwellendam, *Burchell*! *in Hb. Kew.* (no. 7342).

Shrub of 1 foot or less. I can find traces of the dissepiment upon one side only of the central column. The ovary and fruit are perfectly symmetrical, and the stigma is undivided.

Mr. Burchell's collection includes a plant nearly allied to *Titt-*

mannia lateriflora, Brongn. *l. c.*, having axillary flowers, and the apex of the ovary free as in that species, but with two distinct styles. The ovary is two-celled, with the ovules in pairs. The young fruit is also wholly two-celled, with a thick bony dissepiment, but I do not remember to have found any seeds. This plant must, I think, be regarded as a link connecting *Tittmannia* with *Brunia*; and I would propose that the former genus, based upon a solitary species, be reduced*. Here is a description of Mr. Burchell's new plant:—

BRUNIA TERES, sp. nov. Erecta, ramulis gracilibus fastigiatis, foliis minutissimis ovatis subtrigonis vel dorso convexis obtusiusculis arcte adpressis imbricatis, floribus axillaribus solitariis sessilibus, ovario $\frac{1}{3}$–$\frac{1}{2}$ infero biloculari, stylis 2 liberis, ovulis geminatis.

Cape: Baviaan's Kloof at Genádendal, *Burchell*! *in Hb. Kew.* (no. 7700).

There yet remains another remarkable *Bruniacea*, also collected by Mr. Burchell, allied in most technical points of structure to *Berzelia*, but wholly unlike that genus in habit. It is a much-branched softly pubescent shrub, with very minute sessile solitary axillary and terminal flowers, frequently shortly spicate. The petals are sessile and certainly valvate, the stamens included, the ovary scarcely or not at all gibbous, with a free apex, as in *Berzelia*, and a solitary suspended anatropous ovule. As there is but a solitary species thus characterized (or two very closely allied) it may be for the present referred to *Berzelia*. The following is a description of it:—

BERZELIA? (§ *Mniothamnea*. Flores minutissimi, in axillis foliorum solitarii, subspicati vel terminales bibracteolati; petala sessilia, æstivatione valvata; stamina inclusa. *An genus proprium*?) CALLUNOIDES, sp. nov. Adscendens vel procumbens, ramulis tomentosis, foliis ovatis concavis callo atro minuto apiculatis, margine dorsoque pilosis vel rarius glabratis.

Cape: Craggy Peak, near Zwellendam (no. 7382), and mountain near Valléy-Rivier's Poort (nos. 7097, 7116) *Burchell*! *in Hb. Kew.*

A divaricate shrub, varying 9 in. to 2 ft. in height.

* M. Baillon ('Adansonia') suggests that *Staavia*, *Linconia*, and *Berardia* should be reduced to sections of *Brunia*, of which genus he would regard *Raspailia* as a uniovulate species; but this view is not likely to find general acceptance.

Note on the presence of Stamens within the Ovarium of *Bæckea diosmæfolia*, Rdge. By M. T. MASTERS, Esq., M.D., F.L.S.

[Read April 5, 1866.]

[PLATE VII]

I OWE to the kindness of our President the opportunity of examining the flowers which form the subject of the present communication, and which afford an illustration of a very rare teratological occurrence.

In the normal flower there is a turbinate hollow calyx, whose limb is divided into five serrated lobes; alternating with these latter, and springing from the throat of the calyx, are the petals. Originating from the same annular disk as the petals are the stamens, seven or eight in number. The ovary is partially adherent, surmounted by a style, with two or three loculi, and an axile placenta, to which several small curved ovules are attached.

The flowers upon which I have now to make a few remarks did not present anything peculiar in their outer parts; it was the ovaries alone which were the seat of the unusual appearances. Partially immersed within the expanded top of the flower-stalk and the calyx-tube, which is continuous with that organ, the ovary with its style complete did not show externally any indication of the change within. On cutting it across, however, in any direction, numerous perfect stamens (filaments and anthers) were seen projecting from the walls of the cavity. In most of the flowers that I examined, the ovary was unilocular; but in a few there was the usual axile placenta; yet even in these latter cases the stamens originated from the parietes of the cavity, and not from the placenta. The stamens presented different degrees of development: in some cases they were fully formed, the anther-lobes open, and the pollen exposed; while in other cases the filaments were involute or circinate, just as the ordinary stamens are in the unexpanded flower-bud. In some cases imperfect stamens were found, mere barren filaments, with or without rudimentary anthers at the top. In no instance did I find a perfect ovule, or, indeed, any trace of ovules. The stamens appeared to be arranged irregularly on the walls of the ovarian cavity; and while they were certainly more numerous at the lower portion (that now generally considered to be formed by the cup-like end of the pedicel), they were not wanting in the upper half of the ovary (or that which is probably formed from the carpellary leaves).

There has, however, been so much diversity of opinion as to the

true morphological explanation of the ovarium of *Myrtaceæ*, and of its placentation, that it would be unsafe to draw any inferences from an isolated case such as the one before us; and as I have made no special study of this order, I content myself with a mere record of the fact.

I may, however, remark that this case differs from most that have been recorded, wherein there has been a more or less complete substitution of anther for carpel, or where the tissues of the carpel have produced pollen, and so taken upon themselves the appearance and functions of anthers. Cases of this kind are not uncommon; but here there were perfect stamens proceeding from perfect and completely closed ovaries. Moquin Tandon * cites from Agardh an instance which seems more closely to resemble the state of things in the *Bæckea*, and which occurred in a double hyacinth, wherein both anthers and ovules were borne on the same placenta. Probably, though the fact is not stated, the ovary of the hyacinth was open; and we are told that the flower was double—that it was in fact modified and changed in more organs than one; while in the *Bæckea* nothing at all unusual was observed till the ovary was cut open. The style was present even in those flowers where there was no axile placenta; hence in these cases it could not be, as Lindley stated it to be in the closely allied *Babingtonia*, a prolongation of the placenta.

EXPLANATION OF THE PLATE.

1. Longitudinal section of flower of *Bæckea diosmæfolia*, showing stamens proceeding from the parietes of the ovary, which in this instance is unilocular.
2. Transverse section of the ovary.
3. Perfect, and 4. imperfect stamen from the ovary. All magnified.

Descriptions of six new Species of simple-fronded Hymenophyllaceæ. By JOHN GILBERT BAKER. Communicated by Dr. HOOKER, V.P.L.S., &c.

[Read March 15, 1866.]

[Plate VIII.]

As the genus *Trichomanes* is defined in the 'Species Filicum,' the section with undivided or slightly lobed fronds very nearly corresponds with four genera of Presl and Van den Bosch, viz. *Cardiomanes*, *Lecanium*, *Hemiphlebium*, and *Microgonium*. Writing in 1846, Sir W. Hooker enumerates nine species. One of these Van den Bosch subdivides into eight; and five additional species have since been described. In the Kew collection there are five more;

* Élém. Térat. Végét. p. 218.

and these it is the principal object of the present paper to characterize. Three out of the five were recognized as distinct, and named in manuscript by Sir W. Hooker. I propose to give a list of all the known species, including the novelties, arranged as in the 'Species Filicum,' separating them into four groups, according to the character of the venation, and the absence or presence of the fainter intermediate veins, which Hooker calls reticulations, and Van den Bosch venæ spuriæ, and to begin in each with the simplest and proceed towards the more divided forms of frond. The genera of Presl are founded upon the number of layers of cellules in the frond, and the circumstance of whether the mouth of the involucre be entire or shows a tendency to divide, as in *Hymenophyllum*, into two distinct lips.

Genus Trichomanes, *Smith.*

Subgenus *Eutrichomanes*, Hooker.

Section 1. *Fronds quite simple, or slightly lobed.*

§ Venation flabellate.

* *Without spurious veins.*

1. T. reniforme, *Forst*; (Cardiomanes) *Presl.*
New Zealand.

2. T. lineolatum, (Hemiphlebium) *V. d. B.*
Tropical America, both islands and mainland.

** *Spuriously veined.*

3. T. peltatum, n. sp. Frondibus imbricatis tenuiter membranaceis sessilibus peltatis suborbiculatis, venis et venulis spuriis flabellatim dispositis, involucris paucis inclusis, ore late dilatato.

Rhizome wiry, slender, wide-creeping, tomentose. Fronds quite sessile, attached to the rhizome near the centre or towards the base, suborbicular in general outline, half an inch to an inch and a half across each way, quite adpressed to the surface on which they grow, and conspicuously overlapping one another, bright green and delicately membranaceous in texture; the margin undulated, wavy, and sometimes rather deeply cleft in a direction from the circumference to the centre; the veins brownish, wavy, and closely placed, several times dichotomous at a small angle, with numerous interrupted spurious veins between them at the margin and towards the centre; sori scattered, one to three in number; involucres cylindrical, coriaceous in texture, more or less exserted, with a very much dilated slightly two-lipped mouth.

Samoa, July 1864, *Powell*, no. 125.

A very distinct plant, most like *T. membranaceum* in texture and appearance, but smaller in size, different in habit of growth, and not furnished with the row of double peltate scales which in that species margin the outer edge of the frond and form the principal characteristic of Presl's genus *Lecanium*. There is a *T. peltatum* of Poiret, which Sir W. Hooker places as a synonym of *Hymenophyllum Wilsoni*.

4. T. MEMBRANACEUM *L.*; (Lecanium) *Presl.*
Tropical America, both islands and mainland.

5. T. CUSPIDATUM, *Willd.*; (Microgonium) *Presl.* T. Bojeri, *Hook. & Greville, Icones Fil.* t. 155.
Mascaren Isles.

6. T. MOTLEYI, (Microgonium) *V. d. B. Hymen. Javan.* p. 5, t. 1.
Borneo.

7. T. GODMANI, *Hook. MS.*, n. sp. Frondibus stipitatis suborbiculatis vel obovatis, marginibus subintegris vel parce lobatis, venis et venulis spuriis flabellatim dispositis, involucris paucis inclusis, ore integro dilatato.

Rhizome wide-creeping, slender, tomentose. Stipes a quarter to half an inch long, tomentose like the rhizome, or naked. Fronds thinly membranaceous in texture, measuring from a quarter to more than half an inch each way, orbicular or obovate, the margin undulated, nearly entire, or slightly lobed, as if furnished with a central costa in the lower part, but flabellately veined above, the veins close, two or three times dichotomous before they reach the margin; spurious venules indistinct; sori one to nine, terminal on the central veins; involucres cylindrical, tapering at the base, quite sunk in the frond, the mouth much dilated but not two-lipped, the receptacle included or exserted.

Gautemala, *Salvin & Godman*; Panama, *Hayes*, no. 33.

Most like *T. punctatum* in appearance; but that falls under *Hemi-phlebium*, this under *Microgonium*. *T. Motleyi* has a frond similar in size and outline, but a solitary completely exserted involucre.

8. T. PUNCTATUM, *Poiret*; (Hemiphlebium) *Presl.*
Tropical America, both the mainland and islands.

9. T. REPTANS (probably of *Swartz*, certainly of *Hooker and Greville* including SPHENOIDES of *Kunze*, at any rate in greater part), (Hemiphlebium) *Presl.*
Tropical America, both the mainland and islands.

§§ Venation pinnate, or fronds at any rate furnished with a distinct central costa from the base to the apex.

* *Without spurious veins.*

10. T. Barklianum, n. sp. Frondibus stipitatis lineari-oblongis indivisis, venis pinnatim dispositis, venulis spuriis nullis, involucro solitario terminali, ore integro late alato.

Rhizome slender, creeping, copiously branched, matted with brown tomentum. Stipes one to two lines long, tomentose. Frond membranaceous in texture, not more than two or three lines long by one broad, in shape irregularly linear-oblong, the edge a distinct undulated line, more or less clearly ciliated, the blade furnished with a distinct midrib, from which proceed, at an angle of about 45°, to the margin, at nearly regular intervals, six to eight erecto-patent lateral veins on each side; intervenary spaces not reticulated; sori solitary, placed at the apex of the terminal vein, into which the base is narrowed gradually; the mouth broadly winged, but not two-lipped; the apex of the frond continuous with the wing on one side; the receptacle equal to the involucre or exserted. Discovered by Sir Henry Barkly, the Governor of Mauritius, and Lady Barkly, at the Tamari cascade in that island. This species and *Hymenophyllum parvifolium*, described below, are probably the most diminutive of known ferns, as it would take upwards of fifty fronds of average size to cover a square inch. This species and the next would probably be considered by Van den Bosch a distinct genus, differing from *Microgonium* by the absence of spurious venules.

11. T. Vitiense, n. sp. Frondibus substipitatis oblongis integris vel bifidis costa centrali sola, venis lateralibus et venulis spuriis nullis, involucro solitario terminali incluso, ore integro subdilatato.

Forming close densely matted patches. Rhizome slender, wide-creeping, branched, tomentose. Stipes one to three lines long, sometimes absent. Fronds linear-oblong or oblong, usually undivided, occasionally emarginate or bifid, quite entire at the margin, furnished with a distinct midrib, but without either lateral veins or spurious venules; involucre urceolate-cylindrical, solitary, terminal, quite sunk in the frond, the slightly dilated entire mouth equalling the margin.

Fiji, *Milne.*

Readily distinguished from the preceding by being without lateral veins. When the frond is forked, the midrib divides and is prolonged down the centre of each lobe.

** *Spuriously veined.*

12. T. Neilgherrense, *Beddome, Fil. S. Ind.* t. 6.

Falls under *Hemiphlebium*, Presl.

Southern Hindostan.

13. T. Petersii, *A. Gray in Sill. Amer. Journ.* 1853, p. 326; (Microgonium) *V. d. B.*

Alabama.

14. T. apodum, *Hooker & Greville*; (Didymoglossum) *V. d. B.*

Tropical America, both the islands and mainland.

Of *T. Schaffneri*, Schldt., and *T. Pabstianum*, C. Muller, placed by Van den Bosch near *T. apodum*, there are no specimens in the Kew Herbarium.

15. T. Henzaianum, *Parish, in Hook. 2nd Century of Ferns*, t. 1.

Falls under *Didymoglossum*.

Malayan peninsula.

16. T. pusillum, *Swartz*; (Hemiphlebium) *Presl.*

Tropical America, both the islands and mainland.

17. T. muscoides, *Swartz.*

Under this, Sir W. Hooker places, in the manuscript notes which were prepared for the 'Synopsis Filicum,' *Hemiphlebium muscoides* and *Microgonium sublimbatum*, *æruqineum* Hookeri, *erosum* Lenormandi, *bimarginatum* and *Kapplerianum* of Van den Bosch.

Tropical Asia, Polynesian Islands, Africa, and America.

18. T. Robinsoni, *Hook.* MS., n. sp. Frondibus stipitatis oblongo-spathulatis subpinnatifidis, venis et venulis spuriis pinnatim dispositis, involucris solitariis vel binis exsertis stipitatis, ore rotundo bilabiato.

Rhizome slender, wide-creeping, tomentose. Stipes one to three lines long, tomentose like the caudex. Frond membranaceous in texture, half an inch to an inch long by from a quarter to three-eighths of an inch broad, oblongo-spathulate in general outline, subpinnatifid, with short, rounded, erecto-patent lobes, of which the two upper ones are the narrowest and longest, furnished with a distinct midrib from the base to the apex; the lateral veins pinnate, erecto-patent; the spurious veins short and indistinct; the margin undulated and slightly toothed, furnished with a few strong deciduous hairs; the sori solitary or in pairs, completely exserted or even stipitate; the involucre cylindrical, with a rounded, distinctly two-lipped mouth.

Natal, at an elevation of 3000 feet, *Robinson, Sanderson.*

This falls under *Hemiphlebium*; but whether it would be best

placed here amongst the simple-fronded species, or amongst the pinnatifid species by the side of *T. quercifolium*, may be considered an open question. It is not at all likely to be confused with any of the species which have been enumerated.

Of the eighteen species, eight are confined to the New World, nine to the Old, and one is common to both. Four only are extratropical, Tropical America producing eight species, the Pacific islands five, Tropical Africa (including the Mauritius) three, and Tropical Asia one. Europe is the only continent from which they are absolutely excluded.

I take also the present opportunity of describing a very minute simple-fronded *Hymenophyllum* from the Malayan peninsula.

HYMENOPHYLLUM PARVIFOLIUM, n. sp. Frondibus lineari-oblongis indivisis vel uni- vel bifurcatis, costa centrali sola, venis lateralibus nullis, venulis spuriis liberis, involucro solitario incluso, ore late alato.

Rhizome slender, wide-creeping, tomentose. Stipes a line long or less, naked or slightly tomentose. Frond two to three lines long by a line broad, linear-oblong, undivided or once or twice cleft at the apex, sometimes slightly, sometimes nearly halfway down, with a central costa only, which runs down the centre of each lobe when the frond is divided; lateral veins none, but marked with faint irregular free spurious venules; the margin slightly undulated, glabrous; the sorus solitary, terminal; the involucre globose-triangular, narrowed into the costa, about as deep as the convex broadly rounded valves.

Moulmein, *Rev. C. Parish*, 1862.

Resembling closely *Trichomanes Barklianum* and *Vitiense* in size and habit, but belonging to *Hymenophyllum* by the structure of the fruit.

Kew, March 1866.

EXPLANATION OF PLATE VIII

A. *Trichomanes Godmani.*
B. *T. Robinsoni.*
C. *T. peltatum.*
D. *T. Vitiense.*
E. *Hymenophyllum parvifolium.*
F. *Trichomanes Barklianum.*
1, in each case, the plant, natural size.
2, portions, more or less magnified.

Notes on Dr. W. L. Lindsay's Paper on *Arthonia melaspermella*. By William Nylander, Esq., M.D. Translated and communicated by the Rev. W. A. Leighton, B.A., F.L.S.

[Read June 21, 1866.]

Dr. Lindsay asserts (Linn. Soc. Journ. vol. ix. p. 281) that I regard *Lecidea lutea* as a fungus; but such has never been my opinion, and never have I expressed such an opinion. In my 'Lich. Scandin.' p. 192, which Dr. Lindsay quotes, I describe (as elsewhere in my other writings) this beautiful lichen as a lichen, without saying a single word which could lead any one to suppose that there was the least doubt that this was anything else than a true lichen. On the same page I speak solely of *Stictis radiata* and *pallida*, Pers., as being properly referable to the fungi, notwithstanding a certain character of the gelatina hymenea by which they approach the *Lecideæ*. I believe that Dr. Lindsay equally deceives himself in wishing to attribute "several forms of spermogone and pycnide" to the same lichen, p. 273. No lichen has ever presented to my observation more than one single kind of spermogonium; and the pycnides are rare, and are not constantly present as the spermogonia; but that which without doubt has led Dr. Lindsay into error is this, that parasites are frequent on the thalli of lichens, and also that it is not rare to see a thallus, especially a pulverulent one, covering another thallus, in such a manner that the two lichens appear to constitute only a single lichen, having three or four organs of reproduction (*appareils reproducteurs*). In like manner we often see a lichen covering a fungus (e.g. *Hysterium pulicare*). The pycnides, which are often regarded as the fructifications of lichens, are, however, very frequently only the fructifications of fungi.

I wish also to be permitted to rectify an error of Dr. Lindsay on page 283. He believes that the *thecæ* contain the *lichenine*; this is not the case. The reaction in these organs is external and superficial. When their summits become blue with iodine, and of a deeper blue than their other portions, this is not the result of a change of colour *within* the cavity of the thecæ, but in the thin layer on their *exterior* surface. Moreover that which in chemistry has been named *lichenine*, is very little known to chemists, and is probably nothing else but the amorphous starch passing more or less into dextrine; and this occasions the

different reactions (blue, violet, vinous red, yellow, or colourless) which are observed in different lichens.

On two new Genera of *Compositæ Mutisiaceæ*, from India.

By Thomas Thomson, M.D., F.L.S.

[Read June 7, 1866.]

[Plates III. & IV.]

1. Nanothamnus, n. g.

Capitulum 5–6-florum, homogamum. Involucrum pluriseriale, imbricatum, squamis extus longe pilosis acutis, interioribus sensim longioribus, intimis basi membranaceis; receptaculum parce fimbrilliferum. Corolla bilabiata, labio exteriore lato 4-lobo, interiore integro longe lineari, tubo extus parce patentim glanduloso piloso; antheræ brevissime caudatæ, caudis acutis. Pollen læve, globosum. Stylus basi bulbosus, ramis filiformibus puberulis. Achenia molliter pubescentia, valide 10-costata, costis apice in annulum cyathiformem achenium coronans coalita. Pappus nullus. Herba facie *Blumeæ*, floribus (e sicco) flavescentibus.

Nanothamnus sericeus, n. sp.

Habitat in collibus aridis provinciæ Concan Indiæ occidentalis.

Herba perennis, pluricaulis, caulibus adscendentibus 3–6-pollicaribus. Folia ovato-oblonga vel ovato-lanceolata, argute serrata, radicalia circa collum fasciculata, caulina alterna, plus vel minus sericea, interdum glabrescentia. Capitula in fasciculos terminales aggregata, vel in axillis foliorum sessilia, vel ramulos breves terminantia.

This very remarkable little plant was sent to Kew some years ago by Mr. Dalzell in a letter; and on examination of the Herbarium, there was found a small specimen in a too advanced state for description, which was sent by Mr. Law many years ago. In some respects it approaches *Dicoma*; but its characters are very well marked.

2. Catamixis, n. g.

Capitulum 5-florum, homogamum. Receptaculum nudum, angustum. Involucrum pluriseriale, imbricatum, squamis exterioribus brevibus ovatis acutis, interioribus sensim longioribus, intimis lanceolato-linearibus acuminatis. Corolla infra medium late tubulosa, supra medium ligulata, lamina apice angus-

tata breviter 5-dentata. Antheræ longe caudatæ, caudis longe plumosis. Stylus basi bulbosus, breviter exsertus, ramis brevibus oblongis, margine et dorso fimbrilliferis. Achenium teres, erostre, dense villosum. Pappus subbiserialis, setis rigidulis scabris. Frutex Himalaicus alternifolius; capitula ad apices ramorum, corymbosa.

CATAMIXIS BACCHAROIDES, n. sp.

Habitat in collibus subtropicis Siwalicis Himalayæ occidentalis prov. Garhwal.

Ramuli teretes, adpresse sericei vel glabrescentes, dense foliosi. Folia 1½-2-pollicaria, obovato-spathulata, petiolo plano basi dilatato semiamplexicauli, coriacea, glabra, grosse sinuato-dentata; superiora ramosa; suprema ad corymbi ramos, bracteiformia, linearia, integra. Corymbus compositus. Capitula gracilia, vix ½-pollicaria.

I found excellent specimens of this very remarkable plant in Dr. J. L. Stewart's collection of West Himalayan plants sent to Kew some years ago. In arrauging the Herbarium of the late Dr. Falconer, I found specimens with leaves only, but no flowers; and Mr. Bentham has been good enough to show me a specimen in his Herbarium, collected by Mr. Edgeworth, and ticketed "*Baccharis oligantha*, DC., in Herb. Royle, in Prodromo omissa." The original Roylean specimen I have not succeeded in finding. This specimen is in very young bud, far too immature to show the generic characters. All these specimens are doubtless from the same region.

The affinities of *Catamixis* point in many directions. Hence the name (κατάμιξις, mixture). The ligulate corolla would technically place it in Cichoraceæ, with which suborder, however, it has evidently no close affinity. The habit is that of a shrubby *Baccharis*, *Pluchea*, or *Pteronia*, and the lobes of the style are very asteraceous. The bulbous base of the style points rather to Mutisiaceæ; and I am induced, after long hesitation, to place it there, from its very evident close relationship to *Leucomeris*, also a West Himalayan genus of one species. In the number of the florets, the long and feathery tails of the anthers, the silky achenes, and, to a great extent, in habit the two agree. The corolla, however, is very different; but that of *Leucomeris*, being quite regular, is exceptional in the suborder. Should *Leucomeris* be removed elsewhere, on a general revision of Compositæ, *Catamixis* must necessarily follow it wherever it goes.

EXPLANATION OF THE PLATES.

Plate III.

Figs. 1, 2. Plant of *Nanothamnus sericeus*, natural size.
Fig. 3. Capitulum.
Fig. 4. Floret.
Fig. 5. Achene.
Fig. 6. Anthers.
Fig. 7. Style.
Fig. 8. Upper part of Style. All magnified.

Plate IV.

Plant of *Catamixis baccharoides*, natural size.
Fig. 1. Capitulum.
Fig. 2. Involucral scale.
Fig. 3. Floret.
Fig. 4. Upper part of Style.
Fig. 5. Hairs of Pappus. All magnified.

Notes on some of the Climbing-Plants near Desterro, in South Brazil. By Herr Fritz Müller, in a Letter to C. Darwin, Esq., F.R.S., F.L.S., &c.

[Read Dec. 7, 1865.]

(Plate IX.)

In your Paper on the "Movements and Habits of Climbing-Plants," you say that you have seen no tendrils formed by the modification of branches, and you even seem to entertain some doubt whether such tendrils exist. In the genus *Strychnos*, the tendrils are called by Endlicher *ramuli cirriformes*, and I have now satisfied myself that they really are of this nature. On the branches of upright shoots of a *Strychnos* which grows here, the tendrils are disposed in a very regular manner. On the branches, the leaves of the first, third, fifth, &c. pairs are horizontal, those of the second, fourth, and sixth pairs are vertical in relation to the main axis; and it is from the angles of every under leaf of these latter pairs that the tendrils spring. Now, on the points commonly occupied by tendrils, true branches are sometimes developed. The leaves from the angles of which the tendrils spring are often much reduced in size, while in other cases they are but little or not at all changed. Each tendril bears near its tip a pair of rudimentary leaves; and whilst very young the tendrils are straight, but soon become curved downwards and rolled into a helix, whether they have clasped a support or not. This *Strychnos* is a very inefficient climber; the short stiff tendrils but rarely catch anything.

A member of the Hippocrateaceæ, probably a *Tontelia*, is likewise a branch climber. One of its branches, three feet in length, had not as yet developed leaves, and resembled a gigantic tendril, with most of its lateral branchlets already grasping neighbouring objects. From the angles of the tendril-branches, other branches arise, which as far as I have seen, are not sensitive, and never clasp anything. This latter arrangement must be serviceable to the plant; for such branches grow upright without being arrested in their course, whilst the plant is secured by the tendril-branches.

Caulotretus, one of the Leguminosæ, offers another case of tendrils being formed from modified branches. In the species which I observed, the branches bear tendrils only in the angle of their first leaf, and this leaf is always rudimentary. In young shoots it might, at first sight, be thought that tendrils spring from the axils of all their leaves. In this plant every tendril appears to consist of two parts, separated by a small swelling—the inferior being straight, the superior curved, with its end rolled into a helix. But what appears to be the inferior part of a tendril is in fact the first internode of a young branch, the swelling being its terminal bud, and the tendril really springs from this young branch, from the angle of its first squamiform leaf, but nevertheless accompanied by two stipules. The end of the tendril very soon rolls up into a helix; but it does not lose by this the faculty of catching a support; on the contrary I know of no other tendrils which become entangled with small objects so easily as these rolled-up, highly elastic tendrils of the *Caulotretus*.

By far more interesting than the tendrils of *Strychnos* and *Caulotretus* are those (Pl. IX. figs. 1 and 2) of a climbing Papilionaceous plant with a woody stem, which from its general aspect I suppose to belong to the *Dalbergieæ*, Benth. They consist of thin, slender, flexible, leafless branches, with numerous (12–25) internodes, armed with sharp, hard, hook-like stipules. The young, soft, herbaceous shoots of this plant which rise from the ground are leafless. I saw one, seven feet high, which in its lower half was naked, while the upper half bore about a dozen tendrils stretched out in every direction. The oldest of these tendrils were from nine to twelve inches long, and armed with from twelve to sixteen pairs of sharp hooks: at the sides of the younger tendrils there were large, foliaceous, deciduous stipules, and at their bases very small bract-like leaves. The hooks of the tendrils are evidently stipules, which so often in this family assume the form of hooks or spines; in fact, while in the older tendrils they are

strongly curved, and have a hard, sharp, darkly coloured apex, at the summits of the younger ones they are straight, soft, and green, resembling in this early state the much larger stipules at the bases of the tendrils. Afterwards, on the summit of the shoot, true leaves are developed at the bases of the tendrils instead of the small rudimentary ones; and finally, when the plant has reached the light, and spreads over the upper surface of a thicket or tree, the tendrils disappear. The inverse may be observed when the plant sets out on the conquest of a new dominion, a neighbouring tree for instance. Then a branch bearing only leaves begins to produce on its tip tendrils supported by leaves, and finally, growing rapidly to a long slender shoot, it produces only tendrils, the leaves being replaced by small squamæ. Thus in this plant, the branches assume four different shapes:—1st, tendrils, leafless, armed with hook-like stipules; 2nd, long, slender, leafless shoots, bearing tendrils and broad deciduous stipules; 3rd, branches with leaves, from the axils of which tendrils spring; and 4th, branches bearing only leaves without tendrils. Between the leaf and the tendril there is an accessory bud (fig. 1 *b*), which often developes into a branch; these branches issuing from the accessory buds seem never to produce tendrils. The tendrils, after having clasped a support, thicken partially where they are in contact with it (fig. 1 *a*). Tendrils which have caught nothing behave in different ways. Some wither and fall after contracting irregularly. Others likewise become flexuous, or contract into a spire, or occasionally into a helix, but remain, thickening somewhat and becoming ligneous and rigid. Others produce branches from one or some of their internodes: this also occurs, and perhaps more frequently, with tendrils which have found a support; in this case the tendrils thicken much, and sometimes attain a diameter of more than one inch (fig. 2 *a*, a thickened tendril clasping a branch of a *Psidium*; *b*, branch issuing from the tendril; *c*, tendril-bearing branch; *d*, branch from an accessory bud, without tendrils). Lastly, the tendrils even transform themselves into true branches: in this case they may remain nearly straight or become but little flexuous, and at their ends they produce leaves; the first of these leaves have sometimes hook-like persistent stipules, like those of the tendril, while the stipules of the following leaves are deciduous like those on other branches. These tendrils often become much elongated. I saw a shoot, almost all the tendrils of which were developed into serpentine branches; and under each of these branches there was a straight branch from an acces-

sory bud. One of the tendrils was thirty inches long; it had twenty-five pairs of hooks, and at the tip three short internodes with leaves and destitute of hooks; from its seventeenth internode a branch arose. Excepting their hook-like stipules, by which they may be easily recognized, the branches formed by tendrils resemble in almost every respect the ordinary branches; but, as far as I have seen, they never produce tendrils, nor do the branches which spring from an internode of a tendril or (as I have already stated) from an accessory bud.

If we restrict the name of tendrils to filamentary organs used *exclusively* for climbing, those of the present plant would be excluded; for after having done their work as tendrils, they may be transformed into, and do all the work of, branches.

While in this plant the highly modified tendrils may be changed again into true branches, in two other plants which I have seen, the branches themselves, without having suffered any modification, act as tendrils. One of these plants belongs to the *Dalbergieæ*. Many of its branches had clasped small branches of a tree. These tendril branches, as they may be called, had not continued to grow beyond the support; and where they touched it, most of them had thickened: some showed a tendency to spiral contraction, forming a semicircle between the support and the stem. The plant does not twine. I may add that another genus, belonging to the same section of the Leguminosæ, namely *Hecastaphyllum*, is also a branch climber.

The second plant above referred to is a *Securidaca* (Polygalaceæ), and a most powerful climber (fig. 3). Its branches often curve in a very odd and complicated manner. Thus I saw a thin branch, which with its lateral twigs had become curved like ribs into semicircles (about four inches in diameter), imitating the bones of the thorax; from the twigs sprang secondary branchlets, which were very regularly curved, twisted together, and formed into a sort of network around the middle hollow space. When the branches wind round a support, they thicken and become more rigid, like true tendrils; but even these thickened parts may bear leaves or secondary branches. In the preceding plant the branches seem to be arrested in their longitudinal growth when they clasp a support; in the present plant they continue to grow, and the same branch may successively catch different objects. The branches which project freely from a thicket are rather thin and slender: with their twigs spreading all in the same horizontal plane and diminishing in length towards

the extremity of the branch, and with their leaves arranged in two horizontal rows, they apparently form gigantic bipinnate leaves; and when covered with their bluish-purple flowers, this *Securidaca* is one of the most elegant and magnificent plants of our flora.

From the last two plants it is but one step to the primordial and simplest condition of branch climbers, exhibited by the numerous species which scramble up a thicket without twining and without the aid of rootlets, hooks, or tendrils.

Thus we can trace in the development of branch climbers the following stages:—

1. Plants supporting themselves only by their branches stretched out at right angles—for example, *Chiococca.*

2. Plants clasping a support with their branches unmodified—*Securidaca* (*Hippocratia* according to Endlicher, Gen. Plant. No. 5700, "arbores v. frutices, ramis contortis scandentes").

3. Plants climbing with the tendril-like ends of their branches. According to Endlicher (Gen. Pl. No. 5745), this is the case with *Helinus* ("ramulorum apicibus cirrhosis scandens").

4. Plants with highly modified tendrils, which may, however, be transformed again into branches—for example, the above-mentioned Papilionaceous plant.

5. Plants with tendrils used exclusively for climbing—*Strychnos*, *Caulotretus*.

I will here add a few miscellaneous observations. You describe some species of *Bignonia* in which the tips of the tendrils become enlarged and adhesive after remaining for a short time in contact with some object; but the trifid tendrils of *Haplolophium*, one of the Bignoniaceæ, terminate (without having come into contact with any object) in smooth shining disks, which, however, after adhesion, sometimes become considerably enlarged. In *Cardiospermum* you state that the common peduncle which bears the subpeduncles with the flower-buds and the pair of short tendrils, although it spontaneously revolves, does not bend on contact or contract spirally; hence it may be worth mentioning, as showing a difference in the action of the tendrils in related genera, that in *Serjania* the common peduncle contracts spirally when the single tendril which it bears has clasped, as frequently happens, the plant's own stem.

With respect to spirally twining plants, you state that though the *Hibbertia dentata* sometimes revolves in one direction and sometimes in the other, yet it invariably twines from left to right.

But in another genus belonging to the same family, namely the *Davilla*, the stem twines indifferently from left to right or from right to left; and I once saw a shoot, ascending a tree about five inches in diameter, reverse its course in the same manner as so frequently occurs with *Loasa*. Although individuals, as we have just seen, in some few cases twine in opposite directions, yet you say that you have not as yet met with any case of two species in the same genus twining in opposite directions, and you are able to give only two cases of species within the same natural order thus twining. But a *Mikania* growing here twines from right to left, whilst the *Mikania scandens* described by you twines in an opposite direction; and I believe that there are species of *Dioscorea* which twine in opposite directions. Lastly, with respect to the thickness of the support which can be ascended by spirally twining plants, I have lately seen a trunk about five feet in circumference which was thus ascended by a plant apparently belonging to the Menispermaceæ.

On a Double-flowered Variety of *Orchis mascula*.

By Maxwell T. Masters, M.D., F.L.S.

[Read Dec. 7, 1865.]

[Plates X. & XI.]

In May last, Dr. Moore, of Glasnevin, laid before the Royal Dublin Society flowers of this curious Orchid, gathered at the Bridge of Allan by Dr. Patterson, and subsequently was good enough to forward the specimens to me for more complete examination and description. Dr. Moore's brief account may be found in the Proceedings of the above-named Society (May 15, 1865); but, as my interpretation of these flowers differs somewhat from that given by my friend, I think it right to reproduce his remarks in this place before proceeding to give the results of my own examination.

"The flowers," writes Dr. Moore, "are reversed on the axis which bears them, the labellum being next the axis in place of the sepals being uppermost, which is the normal state of the flower. The changes of the parts are very curious and interesting. On the sides of the labellum are two smaller labella with short spurs; and in the axils of these, other flowers spring, thus rendering the morphology axillary. These secondary florets have, again, rudimentary florets in the axils of their changed labella; there is no

ovary or column or nectary distinct, though in some instances, in the secondary flower, they are apparently present in a very rudimentary state. The part where the column ought to be in the general flower, is a mass of bracts and incipient florets, forming a depressed raceme, thus showing the prolification to be median also. The malformed parts in the incipient flowers do not appear to exceed the usual number of pieces in the regular flower of *Orchis*." On examining the flowers to which Dr. Moore thus alludes, I was struck, in the first place, with the general appearance of the spike—the somewhat globular flowers, which were very densely packed, giving a very different aspect to the plant from that which it usually has. The flowers had, as the able curator of Glasnevin truly states, their labella directed towards the axis, instead of towards the bracts as in ordinary *Orchis*-flowers. If I may be allowed the comparison, I should say that the flowers very much resembled, except in colour, miniature cabbages (Pl. X. fig. 1). In the description above cited, the blossoms are said to be destitute of ovaries; but in those which I examined, these organs were present, but, as they were not twisted as usual, they more nearly resembled, in outward appearance, pedicels than ovaries. A cross section, however, revealed a single cavity, with (in some instances) traces of placentæ and ovules (Pl. X. fig. 2). The untwisted state of the ovary is, as is well known, the original condition of all Orchids, and it serves to account for the unusual position of the labellum with reference to the axis of the plant. Surmounting the ovary were the floral whorls, which, for the convenience of description, I will arrange in seven series, the eighth and succeeding whorls being in too rudimentary a condition and too closely crowded to admit of satisfactory examination (Pl. XI. I.). The first whorl consisted of three sepals—two posterior, and one anterior (Pl. XI. I. 1, 1, 1). These did not differ from the outer perianthial segments of an ordinary *Orchis*. Alternating with these sepals were three petals (Pl. XI. I. 2, 2, 2), constituting the second whorl: of these one was a labellum, placed next the axis, and provided with a spur, this latter appendage, however, being in some cases absent. The other two segments resembled ordinary petals, but each one had in its axil a secondary flower-bud—axillary prolification (Pl. X. fig. 3). No trace of column was to be seen, but in its place a third verticil, consisting of three petals, alternating with the members of the preceding whorl (Pl. XI. I. 3, 3, 3): the anterior one bore a rudimentary anther (Pl. X. fig. 4); while the other two resembled labella in

having small, tubular spurs (Pl. X. fig. 5); they had, moreover, flower-buds in their axils: thus, in this third series, there was an attempt to form an anther and at the same time nectaries. The fourth whorl was made up of three or, sometimes, of only two sepals (Pl. XI. I. 4, 4, 4): if three in number, they alternated in position with the segments of the preceding series; if two only were present, they were so placed as to show that it was the posterior one that was deficient: an axillary bud was present in all cases. The fifth whorl, in the more perfect flowers, consisted also of three pieces (Pl. XI. I. 5, 5, 5), like the others; and all of them were provided with axillary buds. Sometimes this whorl was represented only by a single piece, placed anteriorly. The sixth verticil was composed of three segments, but generally of only two, placed laterally (Pl. XI. I. 6, 6). The seventh circle was rarely complete, being generally reduced to a single sepal with the trace of a bud in its axil, and placed in the fore part of the flower (Pl. XI. I. 7).

The centre of the flower, within this seventh whorl, was in so imperfect a condition that its parts could not be satisfactorily dissected.

Before proceeding to the description of the axillary buds, it may be well to inquire whether these seven whorls of the primary flower, just described, are parts of one and the same flower, or whether they are representatives of a series of imperfect flowers, produced, one above another, by median prolification. To this end I must refer to the views held by Robert Brown and Darwin on the theoretical construction of Orchidaceous flowers*. Assuming the correctness of those views, there should be in a perfect Orchid fifteen parts, arranged in five whorls (Pl. XI. II.).

Now, in the flowers which form the subject of this note, the two outermost whorls belong to one and the same blossom, of which they formed in fact the calyx and corolla. The third whorl probably belonged to the same flower, inasmuch as it presented traces of a stamen corresponding precisely to that marked A 1 on Darwin's diagram, but differing from the stamen usually found in this situation in being perfectly free and distinct; indeed there was no style for it to adhere to; the two lip-like organs of the same set correspond to A 2 and A 3 (Pl. XI. II.), which are usually confluent with the labellum, but which are in this case distinct and more leaf-like in appearance than staminal. The fourth whorl would correspond to stamens *a* 1, *a* 2, *a* 3 (Pl. XI. II.); and it may

* Darwin, 'Fertilization of Orchids,' p. 292.

here be remarked that if in this whorl one segment were absent, it was precisely the one which in the natural flower is deficient. In the untwisted flower this would be posterior; but in the ordinary blossom it would be anterior, as shown in *a* 3 (Pl. XI. II.).

The fifth whorl would correspond to the stigmas (S, Pl. XI. II.); and here, again, it must be noted that this whorl is rarely complete, but is most generally represented by one segment, placed anteriorly (in the untwisted flower), and thus corresponding to the single stigma always present in Orchids, and which in the reversed flowers is placed posteriorly.

So far, then, the first five whorls of these double Orchids coincide exactly in position with the whorls of the theoretical *Orchis*-flower; but, as happens in many other double flowers, the stamens and pistils are represented by petaloid organs.

The sixth and seventh whorls, on this view, would be accounted for by a process of multiplication or of increased numerical development, such as is so common in double flowers.

Hence, then, I am disposed to regard these flowers as doubled, first, by the substitution of petaloid organs for stamens and pistils, the several parts not becoming fused one with the other, and, next, by an increased development of perianthial segments in the centre of the flower.

The other mode of explaining the conformation of these flowers is that afforded by median prolification; and this is the explanation adopted by Dr. Moore; but the perfect mode in which the members of one series alternate with those of adjacent rows, and their strict conformity in position to the organs of a normal *Orchis*-flower, induce me to think that there is no median prolification, so far as the primary flowers are concerned. Moreover, if these flowers were the subjects of median prolification, there would be an internode separating one flower from another, as well as traces of bracts and of ovaries; but none of these were to be seen. With reference to this point I had the advantage of comparing these specimens with some flowers of *Orchis pyramidalis*, also forwarded by Dr. Moore, and which were really prolified. These have been previously brought under the notice of the Society*.

I must now mention the adventitious buds which were found in the axils of some or all the members of the six inner whorls of the primary flower, the outermost series having presented none of these axillary developments. The most completely formed of

* Journal of the Linnean Society, (Botany) vol. viii. p. 211.

these secondary axillary flower-buds (Pl. X. fig. 6) had small bracts at the base of the rudimentary ovaries; at the summit of these latter were three sepals of the ordinary form, but which, in some instances, showed indications of a tubular spur. Within these sepals, and separated from them by a short internode (apostasis), were the petals, two of them like the sepals in form, the third lip-like but turned on one side to avoid the spur of the sepal. Both sepals and petals had rudimentary axillary buds, which I may here call tertiary axillary buds. Next in order to these petals was, in some cases, a single petaloid stamen, while in other instances two such organs were present (Pl. X. figs. 7, 7 *a*). These stamens had broad, petal-like filaments, bearing at their upper end brownish anthers, adherent to the back of the filaments, and bursting, as it would seem, by a horizontal chink near the top. These anthers were in some cases surmounted by a small triangular appendage continuous with the filament. The pollen-masses (Pl. X. fig. 8) were of the usual form, but had only very short rudimentary caudicles. No rostella or viscid disks were to be seen; but the centres of the flowers were occupied by other, miniature florets (Pl. X. figs. 9, 9 *a*), which I shall speak of as tertiary median florets. These latter had three equal sepals, at the top of a rudimentary ovary. In their axils were incipient quaternary axillary buds (Pl. X. fig. 10). Next came the minute equal petals, alternating with the sepals; while quite in the centre was a dome-shaped mass of cellular tissue, not as yet marked out into separate portions.

Hence, then, the secondary axillary flowers were the subjects of both median and axillary prolification, the median florets being again prolified, but the quaternary buds in this series are axillary only.

To make this somewhat complicated description more clear, it may be well to give a brief summary of the main points of interest presented by these flowers. First, then, there were the primary flowers, composed of five distinct whorls, and at least of two others less perfectly developed. These primary flowers did not give rise to median buds, but they produced secondary axillary buds (Pl. XI. III. 2). These latter were themselves the subject of tertiary prolification of both kinds, median and axillary (Pl. XI. III. 3, 3′, 3′). The tertiary median buds (3), like the primary flower (1), did not develope median buds, but only lateral ones—quaternary axillary prolification (4′, 4′).

Since publishing my paper on a partially double flower of

Ophrys aranifera†, wherein I stated that the only figure of a double *Orchis* then known to me was in Jacob's 'Flora of Faversham,' 1777, I have met with a paper of the late Professor Morren, in Bull. Acad. Roy. Belg. t. xix. part ii. p. 171, accompanied by a figure. These flowers were untwisted, and evidently owed their double condition to a substitution of petals for stamens; no prolification of any kind is mentioned. So far as mere outward appearance goes, Dr. Moore's specimens more nearly resembled those of Jacob than those of Morren, but, as the former gives no description, I have no means of comparing them‡.

EXPLANATION OF THE PLATES.

Plate X.

Fig. 1. Double flower of *Orchis mascula*. * The situation of the axis.
Fig. 2. Cross section of the ovary.
Fig. 3. Flower-bud in axil of petal of primary flower.
Fig. 4. Petaloid stamen from the same flower.
Fig. 4 *a*. Corresponding organ in another flower, showing vertical dehiscence of anther.
Fig. 5. Tubular petals belonging to the same whorl as fig. 4, and representing stamens.
Fig. 6. Axillary bud from primary flower, sepals reflected to show inner organs.
Figs. 7, 7 *a*. Stamens from axillary buds.
Fig. 8. Pollen-mass from stamen fig. 7.
Fig. 9. Tertiary floret formed in the centre of the secondary axillary flowers.
Fig. 9 *a*. Similar floret from another flower.
Fig. 10. Quaternary bud from the axil of sepal of tertiary floret.

All the figures are magnified.

Plate XI.

I. Diagram showing the arrangement of the several organs in the seven outer circles of the flower. Each whorl is numbered, and the position of the axillary buds shown. * The situation of the axis.

II. Diagram showing the theoretical structure of an *Orchis*-flower (modified from Darwin).

1, 1, 1. The three sepals.
2, 2, 2. The three petals.
A 1, A 2, A 3. The three outer stamens.
a 1, *a* 2, *a* 3. The three inner stamens.
S, S, S. The three stigmas.
* The situation of the axis.

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† Journal of the Linnean Society, (Botany) vol. viii. p. 207.

‡ Through the kindness of Dr. R. Hogg, I have this year (1866) been enabled to examine another specimen of this double *Orchis*, gathered in the same locality as that from which Dr. Moore's specimens were derived. The structure was in all essential points identical with that above described.

III. Diagram to explain the construction of the double-flowered *Orchis*.

1. The primary flower, with no median bud, the position of which, had it been present, is shown by the dotted line.
2. One of the axillary buds proceeding from 1, and itself giving origin to
3. Median bud, and 3′, 3′, axillary buds.

4′, 4′. Axillary buds, proceeding from 3. No median bud is produced from 3; what would be its situation is indicated by the dotted line.

Note on the Structure of *Indigofera*, as apparently offering facilities for the intercrossing of distinct flowers. By the Rev. George Henslow, M.A., F.L.S. [With additional Notice of Dr. Hildebrand's Paper on *Medicago*, *Indigofera*, and *Cytisus*, in the Botanische Zeitung, March 1866; and a Communication from Mr. Darwin on the Common Broom (*Cytisus scoparius*).]

[Read April 19, 1866.]

The structure of the flowers of *Indigofera speciosa* is as follows:—

The vexillum is orbicular, and inserted by a very short claw, which is nearly at right angles to the expanded lamina.

The claws of the alæ are short, and, near the expanded portions of the petals, somewhat broad; each claw terminates in two points, the lower being that by which this petal is inserted, the upper points, which are bluntest, converge towards, and meet together at, the point of insertion of the vexillum. A superficial ridge runs down the exterior surface of each claw, and terminates in the upper and blunt extremity. The entire inner margins of the alary petals, which are somewhat thickened or involute, touch each other over the staminal tube. The expanded portions of the alæ are somewhat rhomboidal in form, and stand in a horizontal position, being elevated by two horn-like projections which spring from the exterior surfaces of the carinal petals.

The carina is boat-shaped, and inserted by a rather broad claw; there are superficial depressions on the exterior surface, to which the involute margin of the alæ slightly cohere. Two horns projecting upwards and backwards, as already mentioned, support the alæ.

The carina entirely includes the stamens and pistil, the style and stigma of which extend considerably beyond the anthers.

If any object, such as a pin, be inserted at the base of the vex-

illum, to which it will be guided by the projecting ridges on the claws of the alæ, and made to touch the point of insertion of the carina, the latter immediately springs violently down, and from being in a horizontal position becomes vertical, by the claw becoming curved at right angles. The alæ also fall laterally, having lost their support. The claw of the carina splits, and detaches itself from the calyx, so that this as well as the other petals now quickly falls off.

In consequence of the sudden jerk thus caused by the fall of the carina, a cloud of pollen is thrown upwards. The connectives terminate in minute points, which by catching against the falling carina may assist in dispersing the pollen, by forming a sort of spring.

In blossoms in which no insect or other means has effected the fall of the carina, the claw of that petal will frequently be found split, and the two extremities entirely detached from the calyx and curling backwards, the carina, however, being sometimes retained in its place by being entangled in the other petals.

Since writing the above note, my attention has been called by Mr. Darwin to a paper by Dr. Hildebrand in the Botanische Zeitung (March 1866), in which he describes and figures the same construction, assuming that it, as well as that of *Medicago sativa* (an account of which was read by the present writer before the Society, Nov. 1865), is adapted for fertilization by insects. He does not, however, infer the probability that it is especially purposed for the *intercrossing of distinct flowers*—for otherwise it is scarcely conceivable that it could be at all advantageous to a plant to have its stamens and pistils so arranged as to be incapable of fertilization of itself, but yet only requiring its own pollen to be transferred to its own stigma. Dr. Hildebrand observed that the discovery of this movement is not entirely new, as in DeCandolle's 'Physiology' we find a description, though to a certain extent erroneous; for he says, "Certain corollas contribute, in a direct manner, to fecundation: thus, *e.g.*, the several parts of the corolla in the species of *Indigofera* and *Medicago* are bound together by a kind of little 'spur;' when the corolla has attained the end of its development, the 'spur' unfastens, the unconfined carina laps down and imparts a shock to the collected stamens, the consequence of which is the falling out of the pollen." Now this I have already shown not to be perfectly accurate: the "spurs" do not become unfastened, at least in *Medicago sativa*, but the carina and alæ drop down in one piece; and, more-

over, although the staminal tube may perhaps rise up spontaneously, yet many flowers wither without the carina having fallen at all. In *Indigofera* the petals are more fugacious, and the alæ are not so firmly attached to the carina as in *Medicago*.

Both DeCandolle and Treviranus (Bot. Zeit. 1863, p. 3) think that this falling of the carina takes place spontaneously at the full development of the flower; and the latter authority calls in question the necessity of insects, now proved by Darwin in *Phaseolus*, *Trifolium*, and *Lupinus*, and even goes so far as to say, "but all these movements occur in the natural development of the parts, and only after self-fecundation has taken place." Dr. Hildebrand thereupon justly remarks that "both these naturalists are right in saying that this movement of the carina may take place spontaneously in the natural development of the several parts of the flower; for specimens (*Indigofera*) completely secured from insects showed the carina lapped back in the oldest flowers. It is quite possible that by this violent motion, produced entirely by the development of the flower, pollen may fly on the stigma from the shock; but on the other hand we must allow that in most cases the flowers will probably be visited by insects and fecundated by their aid before they have, in the process of their development, advanced as far as the lapping back of the carina. This is the point which is my ground for the conjecture that in these cases, although self-fecundation may be possible, yet, doubtless, in nature, insects mostly anticipate the natural course in the development of the flower, by causing the above-mentioned movement, in the search after honey."

But it seems to me that Dr. Hildebrand does not quite reach the probable motive; and that is, as I have already said, the *intercrossing of distinct flowers*: for in all these cases, although self-impregnation may be possible, and the aid of insects may enhance that end, yet at the same time by the flowers being so contrived as to specially load the insects that visit them with pollen, the inference cannot be avoided, that the intercrossing is the most important end.

Dr. Hildebrand also describes the structure of *Medicago sativa* somewhat similarly to the present writer, a notice of which will be found at page 327.

Lastly, he describes an apparently very feeble imitation in *Cytisus canariensis* and *albus*.

"The anthers," he observes, "open in this species in the bud, and the stigma is already developed at that time; but it pro-

trudes above the anthers, and no pollen can get to it from the anthers. By pressure from above on the carina it is bent a little downwards, while anthers and pistil follow in this direction, but then fly upwards with elasticity, when the pollen flies forth in a small cloud, and a portion of it settles unfailingly on the stigma. According to my observations, in this case no sinking of the carina occurs in the last stage of the development of the flower as in *Indigofera* and *Medicago*. Hence (he concludes) fecundation only happens through the aid of insects, since the lapping down of the carina is not the completion of the flower's development."

In connexion with these observations I would wish to quote a description of the somewhat similar construction in *Cytisus scoparius*, kindly communicated to me by Mr. Darwin. He says, "In the Broom, if the flowers be protected from insects, the parts (stamen and pistil) do not spring out, and scarcely any pods are produced. In a flower lately expanded, when a bee alights on the keel, the shorter stamens alone are ejected, and they dust the abdomen of the insect. When the flower is a day or two older, if a bee alights on the keel, the pistil and longer stamens spring violently out, and the hairs on the pistil deposit plenty of pollen on the bee's back, against which the stigma is rubbed. When the bee flies away, the pistil curls still more, and the stigmatic surface becomes up-turned, and stands close to the protruded anthers of the shorter stamens. We have seen that the bee gets dusted in its abdomen from the shorter stamens of the younger flowers; and this pollen will be left on the up-turned stigma of the curled pistil of the older flowers. Thus both the upper and lower surface of the bee gets dusted with pollen, which will be transferred to the stigma at two different periods."

Hypochlorite of Lime and Hydrate of Potash, two new Criteria in the study of Lichens. By WILLIAM NYLANDER, Esq., M.D., translated and communicated by the Rev. W. A. LEIGHTON, B.A., F.L.S.

[Read June 21, 1866.]

I. HYPOCHLORITE OF LIME.

IT is known that the colouring-matter of *Roccella* separates itself and is easily obtained, if we malaxate or rub between the fingers,

for example, the *R. Montagnei*, immersed in water, which in consequence becomes milky; when settled it deposits a whitish powder, which contains erythric acid. The anatomical structure of the thallus of the *Roccellæ* teaches us how it happens that this colourable matter permits itself to be expressed by such a manipulation; for the surface of their thallus is not covered by any tegumentary or cuticular layer, the cortex being simply composed of short filaments (in length 0·015–0·025 millim., and in thickness about 0·004 millim.) juxtaposed and erect, so that their approximate summits constitute the surface of the thallus. Of this I have given a representation in my 'Synopsis methodica Lichenum,' vol. i. t. 8. f. 3. These cortical filaments have the narrow interstices between them, and also their summits, powdered over with a white powder, which may also be seen, but much more rarely, in the medulla formed by the entangled prolongations of the short straight filaments of the cortex. On adding ammonia, we see, under the microscope, the molecular granulations of this powder to be immediately dissolved, and the preparation under examination becomes clear by the disappearance of this powder.

The particular structure of the external portion of the thallus explains how the lichen, saturated with water, on being rubbed, so readily parts with the free powder which covers and adheres to the filamentous anatomical elements above mentioned. The whitish powder thus obtained, liquefied by a solution of hypochlorite of lime, instantaneously assumes a red colour, which I call *erythrinic*, and which is very vivid, but somewhat fugitive. The same colour immediately appears if we apply this reactive to the surface of the thallus in question. For this purpose it is not necessary to have a filtered solution, but it is sufficient to place in a bottle with a wide mouth and a glass stopper a certain quantity of fresh hypochlorite of lime and to pour water upon it; the water is quickly impregnated, and the liquid will continue clear if the bottle be not shaken. A glass rod ("*agitateur*," chemicè) dipped in the liquid, and applied to the thallus of the *Roccella* rich in colourable matter, immediately exhibits the beautiful erythrinic action. Thus are we enabled to say what is the quantity of this colourable matter which the different species of the genus contain, it being in fact a sort of immediate analysis. We thus establish as a fact that this matter is formed and excreted on the outside of the gonidial layer, and, on the other hand, that towards the interior, in the medulla, there are only feeble traces of it.

On submitting a transverse slice of *Roccella Montagnei* to the

action of the hypochlorite of lime, it exhibits only an elegant zone all round, and of the thickness of the cortical layer*.

Let us now see, by the aid of the new method, what are the reactions presented by the different species of *Roccellei*.

1. We may first of all remark that those which are the richest in colourable matter are the *Combea mollusca*, *Roccella Montagnei*, and *R. sinensis*.

2. Those which are less rich in the colourable matter are the *Roccella tinctoria* and *R. phycopsis*, which scarcely differ specifically, and cannot always be distinguished from each other. Their young thalli present the most beautiful reaction, their older thalli being very little coloured. *R. fuciformis* ordinarily exhibits the curious peculiarity that its thallus is not coloured by the reaction, which on the contrary gives to the soredia of this species the most vivid red colour. It is a curious thing that neither the soredia of *R. Montagnei* nor of *R. phycopsis* exhibit any such reaction†.

In the *R. fuciformis* (fertile) collected in the Isle of Berlengas, in Portugal, by Dr. Welwitsch, I have seen some reaction, especially at the extremities of the branches of the thallus.

3. No reaction is visible in *Roccella hypomecha* (Ach.), *R. Gayana*, and *R. leucophæa*.

Thus are we now able, with the aid of the hypochlorite of lime, with great facility to separate and distinguish the species of this difficult genus, in which heretofore the determinations have been often uncertain. This reactive manifests also this remarkable fact, that determinations perfectly exact ("à l'état actuel de la science") may be made even on specimens which are in a young and sterile state, and in other respects very incomplete.

But it is not to the *Rocellei* alone that the application of this practical mode of study is limited. I have in my writings noticed the analogy existing between the *Roccellæ* and the *Dirinæ*, the latter appearing in reality to be *Roccellæ* with a crustaceous thallus. The hypochlorite of lime confirms this analogy. The *Dirinæ* exhibit a very distinct erythrinic reaction. In *Urceolaria scruposa* and its allies the reaction is produced immediately the thallus is touched by the reactive. By these means we also learn that

* At the same time I would remark that the medulla in *R. Montagnei* is coloured blue by a solution of iodine. For this I use the following mixture:—iodine 1 grain, iodide of potassium 3 grains, and water ½ ounce.

† It is necessary here to guard against error, since that portion of the thallus which surrounds the soredia, on being coloured by the reactive, will transmit the red colour to the soredia, if too much of the liquid reactive be used.

Lecanora tartarea does not differ specifically from *pallescens*, whilst, on the contrary, *parella*, which hitherto has been united with *pallescens*, must now be separated from it, since its thallus does not exhibit any reaction with the hypochlorite of lime. The reaction is also observed in *Lecanora Reuteri* and its neighbours, *Lecidea decolorans* (and *flexuosa*), *Lecidea sarcogynoides*, Krbr., &c.

Notwithstanding, it is perhaps in the *Parmeliæ* that the erythrinic reaction presents the most remarkable advantage as the means of distinguishing between those species which differ very little in external appearance. In reality the colourable material in the *Parmeliæ* is found underneath the gonidial layer, and not upon it or in its exterior as is the case in the *Roccellæ*. Consequently it is necessary to cut the thallus of a *Parmelia* so as to expose the medulla, whenever we wish to ascertain whether the species exhibits the erythrinic action or not on the application of the hypochlorite of lime.

On examining *Parmelia tiliacea, carporhizans, revoluta, Borrerii, olivetorum* (Ach.), *osteoleuca, hypoleucites, polycarpa*, we immediately find that their medulla becomes of an erythrinic red colour. (In some of these species, however, this colour has a rosy tinge.) Most of them contain more colourable matter than the best *Roccellæ*.

In other *Parmeliæ*, on the contrary, we do not observe any such reaction. Among such are *P. saxatilis, perlata, perforata, tenuirimis*, Tayl., *reducens, cervicornis, lævigata, sinuosa, mutabilis, physcioides, livida, hypotropa, caperata*, the species belonging to the groups of *physodes*, of *conspersa*, of *olivacea*, &c.

The reactive thus demonstrates in the most decided manner, for example, that *P. olivetorum* (*P. perlata*, var. *olivetorum*, Ach.) is a species perfectly distinct from *perlata*, with which it has been hitherto united. Certain organic differences without doubt also afford constant marks of distinction between the two species; but these marks are much less apparent and much more difficult to verify than the chemical difference here noted; so that we must no longer confound them, as has been hitherto done in all the herbaria, since the most inexperienced person is now able to distinguish them by means of the reactive. In Moug. St. Vosg. 48, the two species *P. perlata* and *P. olivetorum* are given under the name of "*P. perlata*;" in Hepp. Flecht. Eur. 580, under the name of "*perforata β. olivetorum*," is given *P. perlata*; in Anzi, Langob. 48, is given the *P. olivetorum*. In the same way we distinguish by these means with the greatest facility the *Parmelia*

*lævigata** and *revoluta*, which have been so often confounded. The *revoluta* is given in Schær. L. H. 612, Zw. Exs. 181 bis B, Heppe, Flecht. Eur. 581, Arn. Exs. 137, Anzi, Langob. 49 & 256 (*angustifolia*, analogous to the var. *dissecta* of *P. lævigata*), most frequently named by these authors "*P. sinuosa*," but distinct from *lævigata* as well as from *sinuosa* (which is only a variety of it) by the evident erythrinic reaction, whilst the *lævigata* and *sinuosa* do not present the least trace of this reaction. The *revoluta* is also distributed in Lechl. Pl. Chil. 855.

By these examples, which may be verified with the greatest ease, I believe that I have sufficiently established the invaluable assistance which the hypochlorite of lime affords us in the study of Lichens. The least frustule of the thallus is sufficient for the verification, without the microscope, of the beautiful chemical character which distinguishes, even in the very youngest individual specimens, the species in which other differences are scarcely visible.

The chemical characters have also this advantage (as I have noticed elsewhere in speaking of the utility of the different reactions obtained with iodine as characters of Lichens), that we are guided by the differences manifested through the reaction to search with more attention for organic characters; and, as a general rule, we shall not fail to find them†.

II. Hydrate of Potash.

A solution of hydrate of potash is of equal practical utility by

* To *lævigata* (Sm.) belongs the *P. sinuosa*, var. *virescens*, of Kphb. Lich. Bay. p. 131, according to a specimen sent by M. von Krempelhuber himself.

† Most of the species of the genus *Umbilicaria* exhibit an erythrinic reaction visible in the medulla, but generally very pale by reason of the small quantity of colourable matter which is to be found in them. The *U. atropruinosa*, *stipitata*, *cylindrica*, *Delisei*, *rugifera*, *corrugata*, *erosa*, *sclerophylla*, do not exhibit any trace of this reaction. The *U. reticulata*, Duf., has an erythrinic medulla; and for this same reason its varieties, *cinerascens*, *microphylla*, and *pallens* (var. *nuda*, Schær. Enum. p. 27), ought to be separated from it. Sometimes in the *Umbilicariæ* the reaction (of a pale red) is observed on the surface of the thallus—for example, in *U. aprina* and *lecano-carpoides*. In certain cases, as in *U. hyperborea*, in some specimens, the colourable matter is in so small a quantity that we can scarcely test its presence, whilst in other specimens, and this most generally in this species, we see the erythrinic reaction, although pale, without difficulty. It is useful for observations in this genus, to have in the herbarium not only well-developed and aged specimens, but also young specimens, which will exhibit the characteristic chemical signs whenever the reaction is feeble or less distinguishable.

the diverse and very evident reactions which it produces on the thalli or the fruits of Lichens; and here the colour produced by the reaction, which in certain Lichens is of a purple red ("rouge pourpré"), and in others yellow ("jaune"), is permanent*.

We will first speak of the intense purple coloration ("pourpre") which potash gives so soon as it is applied to the thalli or to apothecia which contain *chrysophanic acid.* The material thus colourable occurs on the surface of those parts of Lichens (the epithallus and the epithecium), and reveals itself by their natural yellow or orange or red colour; the chrysophanic reaction, either purple or very deep purple, shows itself at the very instant of the application of the potash, which acts by dissolving the epithalline or epithecial powder (*i.e.* the molecular granulations which contain the colourable material) into a liquid of a purple colour. It is very easy to convince ourselves of the importance of this distinctive sign, according to its existence or non-existence in the Lichens which we are studying or determining. Thus, for example, a Lichen which is eminently chrysophanic is the common *Physcia parietina*† and its variety *lychnea*, which has been very often confounded with the *Lecanora candelaria*, Ach., and which in a sterile state it is not always easy to distinguish; but the potash shows their differences instantly in the very least atom of their thalli or their fruits; for the *candelaria* is not changed in colour by this reactive, whilst the *lychnea* becomes of an intense purple. This is so evident that we are by these means able to recognize either the one or the other of these two Lichens, even without opening the papers in which they may be enveloped, provided the paper be permeable by the solution of potash; for if it be the *lychnea*, the paper is immediately coloured; but if it be the *candelaria*, the paper remains uncoloured. This absence of reaction indicates that we must arrange the *candelaria* in the group of *Lecanora vitellina,* in which the potash does not produce any change of colour. For the same reason we must refer to the

* We shall speak further on of a modification of the yellow ("jaune") reaction, which quickly changes into a red or reddish ochre ("rouge" or "rougeâtre ochracé") in certain Lichens.

† Nevertheless I must mention that the forms of this species (and of the neighbouring species) which grow in the shade, and of which the thallus then becomes green or grey, do not exhibit the chrysophanic reaction, except on the circumference of the thallus and on the epithecium. The same thing takes place in *Physcia flavicans, chrysophthalma,* &c., in *Lecanora murorum,* f. *virescens,* &c.

affinity of *vitellina* the Lichen which I have described under the name of *Placodium medians*, and which but for the reaction we should have taken for a variety of *murorum*; but in reality *Lecanora medians* is very near to *L. crenata*, Nyl. (*Lichen murorum*, var. *crenulatus*, Whlnb. Lapp. p. 416), and is distinguished from this latter in the same way as *epixantha*, Ach., from *vitellina* *. The species of the group of *Lecanora cerina*, on the other hand, always exhibit the chrysophanic reaction, at least on their apothecia and on their thalli, if these are of a yellow colour. This reaction, moreover, is visible (and constantly intense) in the yellow *Physciæ*, in the yellow species of *Placodium*, in the apothecia of the erythrocarpous *Cladoniæ*, in the apothecia of *Lecanora ventosa*, *hæmatomma*, *erythromma*, in *Lecidea Domingensis*, *flavocrocea*, *chrysosticta*, *leucoxantha*, *cinnabarina*, *russula*, &c.

The potash gives also quite another reaction, that of *usneic* and *lecanoric acid*, *i.e.* a yellow or greenish yellow ("jaune ou jaune-verdâtre") reaction, and that very frequently, on the thalli of Lichens. By the presence or absence of this yellow reaction, we can equally distinguish many species in a manner far easier and more certain than by the ordinary characters hitherto affixed to them. Thus, *Lecanora subfusca* exhibits the yellow reaction; but *umbrina*, *crenulata*, *conferta*, do not exhibit it.

A third reaction obtained with the potash is that of which *Lecanora cinerea* offers an example: the thallus at first becomes of a yellow colour, but in less than a minute the yellow colour is changed into a red colour. In *gibbosa* (and *calcarea*, *lacustris*, &c., which do not differ from it except as varieties), so often difficult to be distinguished from *cinerea*, there is no reaction with the potash. The *cinereo-rufescens*, Anzi (Langob. 73), which exhibits the reaction of *cinerea*, is nothing more than a variety of *cinerea* (which we may name *phæopta*), whilst the true *cinereo-rufescens* and its forms *diamarta* and *obscurata* are distinguished by the absence of all reaction with the potash. The reaction of *cinerea* is found also in *Lecanora oculata* †, but no reaction in *mutabilis* and *verrucosa*. The thallus of *Lecanora blanda* becomes at first yellow,

* The absence of the chrysophanic action is observable also in a great number of Lichens which have yellow or orange thalli or apothecia,—*e.g.* in the yellow species of *Platysma*, in *Lecanora chrysophthalma*, *epanora*, *Schleicherii*, *chlorophana*, *oreina*, in *Dermatiscum*, in *Lecidea lucida*, *geographica*, in *Thelocarpon*, &c.

† In *Parmelia acetabulum* the thallus presents nearly the same reaction as that observable in *Lecanora cinerea*.

afterwards of a red, almost purple colour. Very nearly the same reaction is visible in *Lecanora ochroidea*, Ach. (Meth. p. 72, sub *Lecidea*); but ordinarily its thallus treated with the potash remains yellow, and the red colour appears only on the thalline margin of the apothecia, thus causing the disk to be surrounded with an elegant red ring. I have distributed the *ochroidea* in my Herb. Lich. Paris. 41.

These examples are amply sufficient, I think, to point out the invaluable aids afforded by chemical reactives in the study of Lichens*.

Contributions to the Lichen-flora of Northern Europe†. By W. LAUDER LINDSAY, M.D., F.R.S. Ed., F.L.S., &c.

WITH a view to extend and improve my knowledge of the variations of those Lichen-species which are natives of Scotland, as well as to add to my Lichen-herbarium, I visited, in the summer of 1857 (August) the Norwegian Alps, and in that of 1860 (June) Iceland and the Färö Islands. While not neglecting the higher and larger lichens, which in all these countries have long been comparatively well known, and which are easily determinable, for the most part or altogether, by naked-eye characters, I devoted myself chiefly to the collection of the more obscure and minute lower lichens—crustaceous or athalline, terricolous, saxicolous, and muscicolous species—which are less perfectly or little known, and which require for their determination the assistance of the microscope, and access, for comparison, to the largest and best lichen-herbaria and lichenological libraries.

Of Icelandic lichens, the latest list, as far as I am aware, is that published by myself in 1861‡. It is a compilation which includes the lists of all previous authors: but their nomenclature is

* The analyses of Lichens made by chemists often fail through the neglect of an exact determination of the species, and probably not less often by the mixture of specimens confounded together and incorrectly assigned to one single species. For instance, that which Robiquot has called "*Variolaria dealbata*," and from which he has extracted *orcine*, is not the *Lichen dealbatus* of Acharius, which does not contain this matter, but is probably *Lecanora tartarea* or *pallescens*, or even *Urceolaria scruposa*, or all these and others intermixed. For the chemist, no less than for the physiologist, it is of the greatest importance to know exactly what is the plant we have under observation—that is, to have well determined the plant which we are studying.

† Being an enumeration of Lichens collected in Iceland, the Färö Islands, and Norway, in 1857 and 1860.

‡ In the "The Flora of Iceland," Section *Lichens*: Edinb. New Philosoph. Journal, July 1861.

that which was current prior to the modern era of lichenology; that, viz., which is characterized by the application of the microscope to the examination of the characters of spores and spermatia. It follows from this that not only must such lists be imperfect or defective as to numerical extent, but there cannot fail to be errors in nomenclature and confusions of diverse species. Both these classes of defects relate chiefly to the more minute and lower lichens, including, *e. g.*, the saxicolous, terricolous, and muscicolous *Lecideæ*. My lists, now subjoined, have the advantage of a nomenclature the most modern and most approved, the most precise and correct—the species having been for the most part determined by my friend Dr. Nylander of Paris, the author of a recent 'Prodromus Lichenographiæ Scandinaviæ'*, which is at the same time the fullest and best Catalogue extant of the Lichens of Northern Europe. It contains, however, scarcely any reference to the lichens of Iceland†.

Similar remarks apply to the lichens of Färö. I know of no list of its lichens the nomenclature whereof is modern and exact; nor is there any reference to Färöese lichens in Nylander's 'Lichenes Scandinaviæ'‡, or in Fries's 'Lichenes Arctoi'§.

Most of my Norwegian lichens, however, are enumerated in Nylander's excellent work, though one or two are not therein mentioned, but are to be found recorded in Fries's 'Lichenes Arctoi,' or in the 'Flora' or other continental Botanical Journals.

In all three lists there are certain species which are interesting either from their absolute rarity, the peculiarities of their distribution, or in connexion with their parallel occurrence in Scotland.

The subjoined Catalogues do not fully represent my collections, and still less the lichen-flora of the countries wherein they were gathered. They represent only such portions of my collections as survived the destructive process of travel in a state fit for preservation in my herbarium and for determination. Wherever I have collected lichens at such a distance from home as to necessitate package, and carriage by public conveyances, I have never failed to suffer a large loss, especially among the more minute and

* Or 'Lichenes Scandinaviæ,' Helsingfors, 1861, p. 312.

† I have recently had an opportunity of examining Fries's 'Lich. Arctoi,' published, however, a year *prior* to Nylander's 'Lich. Scand.' It contains only twenty-six species (collected by Steenstrup, Mörck, Vahl, and others) specially mentioned as Icelandic.

‡ Nylander writes me (Feb. 9, 1866), "Sur les Lichens de Färö je ne connais *rien* de publié."

§ "Lichenes Arctoi, Europæ Grœnlandiæque hactenus cogniti," by Th. M. Fries, Ph.D. Upsal. (Trans. Royal Society of Sciences of Upsal, 1860, pp. 298).

obscure terricolous species, which are the most interesting, and contain, in countries not yet thoroughly explored, a large proportion of novelties. The larger, foliaceous, filamentous, and fruticulose species, such as the genera *Parmelia*, *Physcia*, *Umbilicaria*, *Peltigera*, *Sticta*, *Cetraria*, *Platysma*, *Collema*, *Leptogium*, *Usnea*, *Alectoria*, *Ramalina*, and *Evernia*, I am in the habit of moistening on collection, and compressing while moist into ball-shaped masses, which carry comparatively well if carefully packed, and only require soaking in water before laying them out for the herbarium. Of this group a large proportion is generally preserved in excellent condition, even though they should not be unpacked and prepared for the herbarium for months after collection. Saxicolous and corticolous species again, if carefully packed like minerals, may also carry comparatively well. But the jolting and attrition to which, even in our railways, steamers, and carriers' vans (and infinitely more so on the rough and rugged roads of mountainous countries, in such vehicles or by such modes of transport as the carriole of Norway, the waggonette of New Zealand, the pony of Iceland), the contents of boxes, however carefully packed, are subjected, prove fatal to a proportion even of saxicolous and corticolous species, and still more so to terricolous, corticolous, muscicolous, or saxicolous *Calicei*, *Bæomycei*, *Stereocaulei*, *Cladoniei*, *Lecidei*, or *Lecanorei*. Thus by travel or transport alone, after collection, I have sometimes estimated my loss as high as one-half of all the species likely to possess interest or novelty.

My collections, moreover, were made within very limited periods and areas. The Icelandic list is the produce of about a week's collection in the district around the capital, Reykjavik, between the hot springs of Laugarness, on the one side (three miles eastward), and the port of Havnafjord on the other (six miles westward). The localities or habitats specially examined were the walls in and around Reykjavik, the moors, and the boulders abundantly scattered thereon, about the old Observatory (56 feet) and Cemetery, the coasts of Reykjavik Bay, and the coast-cliffs of the island of Videy in the same bay. The Reykjavik district consists mostly of what would be called in Scotland "moorland," or of a more or less barren stony desert comparable with the "Tundras" of Eastern Lapland as these have been recently described by Fellman. No hills were visited, nor heights above about 100 feet, nor did my excursions extend inland more than three miles from the coast. The species collected were mostly saxicolous, and largely also terricolous and muscicolous. *None were corticolous*, in consequence of the total absence of trees and comparative absence of shrubs—a

striking peculiarity as contrasted with the lichen-flora of Scotland or Norway. The *geological basis* of the district includes the following rocks, which for the most part constituted the habitats of saxicolous species; while the soil resulting from their disintegration and decomposition supported, directly or indirectly, the terricolous and muscicolous forms:—viz. lavas, trachytes, basalts, porphyries, and amygdaloids*.

My Färöese list is the produce of a single day's collection in the immediate vicinity of the capital, Thorshavn. The localities and habitats visited or examined were chiefly the walls of the houses and gardens of the town, the rocks on the coast about the fort, and the rocks and boulders of the hills behind the town up to about 500 feet. The dominant rock was a basaltic porphyry, or porphyritic basalt.

My Norwegian excursions extended over about a fortnight; and their centre point was Jerkin (4594 feet), in the midst of the Dovrefjeld range of mountains, on the flanks of Sneehätten, which I also ascended to its summit (7620 to 7714 feet†). I had afterwards the pleasure and advantage in Christiania of meeting the late Professor Blytt, who favoured me not only with interesting details regarding the rarer lichens of the Dovrefjeld, but with specimens of some thereof from his herbarium. He regarded Kongsvold as the best station for head quarters in the collection of the alpine lichens of Norway; and he complained of the general habit of foreign botanists of selecting Jerkin in preference. In other words, while foreigners generally select the saddle or *southern* side thereof as their botanizing head quarters in the Dovrefjeld, local botanists have found the *northern* side much more rich and prolific. Doubtless the selection of Jerkin by English and continental botanists has been determined on from the testimony of maps and guide books, which show that this favourite station has the superior advantages of greater elevation (4594 feet) as contrasted with Fogstuen on the southern declivity of the saddle of the mountain-range (3150), and Kongsvold on its northern side (3063), greater proximity to Sneehätten (which, notwithstanding its in-

* A fuller account of the geology of the district will be found in the following papers by the author.—1. "On the Eruption in May 1860 of the Kötlugjá Volcano, Iceland," with Map, Edinb. New Philosoph. Journal, January 1861. 2. "Contributions to the Natural History of Volcanic Phenomena and Products in Iceland," Proceedings of the Royal Society of Edinburgh, December 17, 1860.

† According to different estimates: 7620, Keith Johnston's Maps, 1861; 7714, Murray's Handbook, 1849. Second in height only to Skagstolstind, which, as given by Keith Johnston (1861), is 8670 feet.

ferior height to Skagstolstind, is still regarded as the monarch of the Norwegian Alps), and its greater profusion of the creature comforts of the traveller. I skirted the base of Skagstolstind, the highest mountain in Norway (8670 feet, Keith Johnstone), but had no opportunity of ascending to its summit. Inasmuch as Sneehätten and Skagstolstind are at no great distance from each other, while the difference in height is not material, the probability is that the lichen-flora of both is greatly the same. I crossed another mountain-range, the Haalangenfjeld (3000–4000 feet), between Romsdal and Loordal, on which I made considerable collections of alpine lichens. The bulk, indeed, of my Norwegian lichens came from the Dovrefjeld or Haalangenfjeld, or, in other words, were *alpine* in their character—a peculiarity which must be borne in mind in any comparison of my Norwegian list with that of Iceland or Färö. To and from Jerkin and Christiania my route included the two great and beautiful valleys of Guldbrandsdal and Romsdal, the former extending from Lillehammer to Laurgaard, the latter from Lie to its opening seaward at Væblungsnæset. I visited also the environs of Christiania (the capital), the northern and southern ends of the Mjösen lake, and the coast-rocks about Christiansand in the extreme south of Norway. The *geological basis* of the districts visited consisted mainly of the metamorphic slates, especially of mica-slate* in all its variations, with its associated quartzites. So abundant frequently was the mica that the slate appeared to consist wholly of this beautiful mineral in foliated dark masses; occasionally its place was occupied by talc or chlorite. Gneiss was also common, and granite, with the various transition forms between gneiss and granite, less so—all sometimes, like the mica-slate, largely micaceous. This difference in the geological constitution of the country must also be kept in mind in instituting comparisons between the lichens of Norway, Iceland, and Färö.

The peculiarities of the lichen-floras of these three countries will probably be best exhibited in the form of separate lists of the lichens collected, having appended a general and comparative table, with such commentaries as the data warrant.

I. *Iceland.*

1. *Ephebe pubescens*, Fr. Saxicolous.
2. *Lichina confinis*, Ag. Saxicolous, common.

* Sometimes highly ferruginous. About Christiania the representative of the mica-slate is a clay (aluminous) slate, which crops out frequently on the sides of the streets and roads.

3. *Pyrenopsis hæmatopis*, Smrf. Saxicolous. Havnafjord.
4. *Sphærophoron coralloides*, Pers. Sterile, in dwarf tufts, of a brownish colour, and resembling some forms of *Cetraria aculeata*: accompanying *Cladonia rangiferina*, *C. uncialis*, &c.
5. *Stereocaulon paschale*, Laur. Various forms, saxicolous, sterile: also Thingvalla, 1855, J. Hewat, in Herb. Univ. Edinb.
6. *S. denudatum*, Flk. Common, frequently sterile.
7. *S. condensatum*, Hffm.
8. *Usnea barbata*, Fr., var. *ceratina*, Ach. (*fide* Nyl. Lich. Scand. p. 69).
9. *Ramalina scopulorum*, Ach. Videy. Very like a saxicolous rigid form of *R. calicaris*, Fr., var. *farinacea*, Ach.; passes into—
10. *R. polymorpha*, Ach., var. *capitata*, Ach. (*R. tinctoria*, Schær.). Videy.
11. *Cetraria Islandica*, Ach., and var. *crispa*, Ach.: both very common.
12. *C. aculeata*, Fr., and var. *muricata*, Ach.: both very common.
13. *Platysma nivale*, L., various forms. Very common; sometimes covers considerable tracts of ground, like *Cladonia rangiferina*: usually sterile, dwarf, and deformed.
14. *P. cucullatum*, Hffm. Terricolous: sometimes accompanying the preceding.
15. *Peltigera canina*, Hffm. Sterile and miserable specimens.
16. *Parmelia saxatilis*, Ach. Saxicolous, very common: sterile about Reykjavik.

   Var. *omphalodes*, Ach. Thallus sometimes deep purplish, with a beautiful peach-coloured bloom, especially about its periphery.
17. *P. lanata*, L. In hollows of boulders, Laugarness moors.
18. *Physcia parietina*, L. Saxicolous: common on walls about Reykjavik; and on marine rocks, Videy.
19. *P. stellaris*, Fr., var. *acrita*, Ach. (var. *aipolia*, Ach.). Muscicolous, Laugarness moors.

   Vars. *leptalea*, Ach., and *tenella*, Ach., and other forms: all saxicolous and more or less common, generally sterile.
20. *P. cæsia*, Hffm. Abundant on walls about Reykjavik: sterile.
21. *Umbilicaria proboscidea*, DC. A specimen in Herbarium, Kew, labelled "Iceland, Mr. Paulsen, 1809," possesses some of the characters rather of *U. cylindrica* on the one hand and *U. hirsuta* on the other. The thallus is of a very pale grey colour, provided with short marginal and rhizinal fibres,

and with abundance of largish submarginal black spermogones*.

22. *U. cylindrica*, Dub.
23. *U. erosa*, Hffm.

All three saxicolous and common.

24. *Pannaria brunnea*, Mass. Terricolous. Reykjavik moors.
25. *Squamaria cartilaginea*, DC. Saxicolous.
26. *S. saxicola*, Pollich. Saxicolous, various forms, very common.
27. *S. straminea*, Ach. Saxicolous. Videy.
28. *S. gelida*, Sm. Saxicolous, resembling my Caledonian-Canal (Scottish) specimens. Krisuvik, Steenstrup.
29. *Placodium murorum*, Hffm. Saxicolous: common on walls and boulders about the shore, Reykjavik.
30. *P. citrinum*, Ach. Associated with the preceding, of which it appears to be only a form.
31. *Lecanora vitellina*, Ach. Saxicolous and terricolous: common on walls about Reykjavik.
32. *L. aurantiaca*, Lightf., var. *erythrella*, Ach. Saxicolous.
33. *L. cerina*, Ach. Terricolous: common on the Reykjavik moors.
34. *L. sophodes*, Ach. "Fere status *lecidina*" (Nyl. MS.), an approach to var. *lævigata*, Ach., both of which are saxicolous and common in Videy.
35. *L. cinerea*, L. Saxicolous, very common.
36. *L. Dicksonii*, Ach. (*Lichen Æderi*, Sm. Eng. Bot. t. 1117.) Allied to, if not a form of, the preceding. Saxicolous. Reykjavik moors; Havnafjord.
37. *L. parella*, Ach. Saxicolous, very common.

Var. *Upsaliensis*, Ach. Muscicolous, very common, sterile. Both forms sometimes sorediiferous (or variolarioid).

38. *L. tartarea*, Ach., var. *frigida*, Sm. Terricolous.
39. *L. poliophæa*, Whlnb., form. Saxicolous, Videy.
40. *L. glaucoma*, Hffm. Saxicolous; frequently sorediiferous or isidiiferous, bearing parasitic fungi, exactly as in Ben-Nevis specimens.
41. *L. subfusca*, Ach. Saxicolous, Videy.

Var. *epibrya*, Ach. Terricolous and muscicolous: common on the moors.

42. *L. umbrina*, Ach. Saxicolous, Videy. A close ally, if not a form, of the preceding.
43. *L. varia*, Ach., var. *polytropa*, Ehrh. Saxicolous, very common.

Var. *intricata*, Ach. Saxicolous, Havnafjord.

* Described in my "Memoir on the Spermogones of the Higher Lichens," Trans. Royal Soc. Edinb. vol. xxii. p. 188.

44. *L. badia*, Ach. (*Lichen picinus*, Dicks.). Saxicolous, Havnafjord.
45. *L. atra*, Ach. Saxicolous.
46. *Lecidea foveolaris*, Whlnb. Terricolous, Reykjavik moors; on soil in crevices of rocks on the coast cliffs, Videy.
47. *L. simplicior*, Nyl. MS. Muscicolous, Laugarness moors. Closely allied to, if not a mere variety of, *L. sabuletorum*, Flk., and *L. sphæroides*, Smrf.
48. *L. umbrina*, Ach. Saxicolous, Reykjavik.
49. *L. bacillifera*, Nyl., var. *subfuscula*, Nyl. (in 'Flora,' 1865, p. 604). Terricolous, Laugarness moors. The type is corticolous in Sweden and Finland. It includes as a variety Borrer's *L. incompta* (E. Bot. Suppl. t. 2699; Leighton's Lichenes Britannici Exsicc. no. 162, *fide* Nyl. Scand. 210).
50. *L. parasema*, Ach., in various forms. Saxicolous, very common.
    Var. *latypea*, Ach. (*L. coniops*, Ach. pr. p.).
    Var. *enteroleuca*, Ach. (*L. dubia*, Borr.).
    Var. *monticola*, Ach. (var. *nitidula*, Fr., Nyl.). Saxicolous, Reykjavik. "Sporæ longit. 0·010–0·014 millim., crassit. 0·0045–0·0050 millim.; hypothecium fusco-rufescens: gelatina hymenea iodo cærulescens" (Nyl. Letter, Feb. 9, 1866).
    Var. *incongrua*, Nyl. MSS. Described as a separate species in Nyl. 'Scand.' 218.
51. *L. vitellinaria*, Nyl. On boulders with rounded surfaces: specimens not obtainable. Probably to be considered a mere parasitic and athalline form of the preceding.
52. *L. alpestris*, Smrf. Terricolous, Laugarness moors.
53. *L. contigua*, Fr. Saxicolous.
    Var. *flavicunda*, Ach., with isidioid forms. Saxicolous, Havnafjord.
54. *L. confluens*, Ach., various forms. Saxicolous. Apt to be confounded with, and properly, I think, referable to, the preceding and succeeding, from which it appears to possess no good title to be considered distinct. Thallus in all three lichens occasionally ferruginous or rust-coloured.
55. *L. lapicida*, Fr., and vars. *declinans*, Nyl., and *ochromela*, Ach. Saxicolous, common.
56. *L. polycarpa*, Flk. Allied like the following to the preceding. Saxicolous, very common.
57. *L. lithophila*, Ach. Saxicolous, very common.
    Form *ochracea*, Ach., according to Fries and Nylander (Scand. 227) is *Lichen pruinatus*, Dicks. (E. Bot. t. 2244).
58. *L. areolata*, Schær. Saxicolous.

59. *L. lactea*, Flk. Saxicolous.
60. *L. intumescens*, Flk. Saxicolous: on boulders with rounded surfaces; specimens not obtainable.
61. *L. petræa*, Flot. Saxicolous.
62. *L. excentrica*, Ach., Nyl. Scand. 233. Saxicolous, Videy. A close ally, if not a form, of the preceding.
63. *L. coniops*, Whlnb., and form *obscurior*, Nyl. MS. Saxicolous, Videy. Described in Nylander's 'Scand.' 237, as a var. of *L. disciformis*, Fr.
64. *L. myriocarpa*, DC., form. Saxicolous, Videy.
65. *L. geographica*, L. Saxicolous, very common.
66. *L. sarcogynoides*, Körb. 252*. Saxicolous. Not mentioned in Nylander's 'Scand.'
67. *Endococcus gemmifer*, Tayl. Saxicolous. Mentioned, in Nylander's 'Scand.' 284, as likely to occur, though not hitherto found, in Scandinavia.

II. *Färö.*

1. *Sphærophoron coralloides*, Pers. Abundant, but not in fruit.
2. *Stereocaulon paschale*, Laur. Also abundant, but not seen in fruit.
3. *Ramalina calicaris*, Ach., var. *farinacea*, Ach. Saxicolous, abundantly sorediiferous, common about the shore. Apt to be confounded with the *R. tinctoria* auctt.
4. *R. scopulorum*, Ach. Abundant on the rocks about the harbour, Thorshavn. Landt describes it erroneously as "very rare."
5. *Cetraria Islandica*, Ach., and var. *crispa*, Ach., Sir W. C. Trevelyan. Mostly on the hills, but probably (at least var. *platyna*, Ach., or the larger forms generally) in small amount; for the Amtman of Färö (Dahlerup) assured me that all the "Iceland Moss" used in these islands (as medicine, not as food) is imported from Sweden. I was further given to understand that this may be the case also with the medicinal "Iceland Moss" used in Iceland itself!
6. *C. aculeata*, Fr., and var. *muricata*, Ach., Sir W. C. Trevelyan.
7. *Parmelia saxatilis*, Ach.† Saxicolous, on the hills; abundant, but seldom in fruit.

Var. *omphalodes*, Ach. Equally common, and infrequently fertile.

8. *Physcia parietina*, L. Saxicolous: on walls of the town and rocks about the harbour, Thorshavn.

* In a letter of date Oct. 12, 1866, Nylander informs me that he now regards this as *Lecidea lapicida*, Fr., var. *declinata*, Nyl.

† The "*Staynamosi*" of the Färöese.

9. *Lecanora vitellina*, Ach. Saxicolous, common.
10. *L. cinerea*, L. Many different forms. Saxicolous, as common as *L. tartarea*.
11. *L. parella*, Ach., and var. *pallescens*, Ach. Saxicolous, very common, especially about the shore. The latter is certainly a transition state to the following species. To the foregoing variety, or its type, appears to belong the bulk of *Isidium corallinum*, Ach., which is also very common.
12. *L. tartarea*, Ach. The "Korke" of the Färöese (Landt). Saxicolous, abundant, both in its usual or fructiferous, and isidioid or variolarioid sterile conditions, on boulders and rocks about Thorshavn, from the sea-level up to the tops of the hills. Landt describes it as so plentiful in some places that at a distance "it makes the stones appear as if they were covered with lime" (p. 195).
13. *L. varia*, Ach., var. *polytropa*, Ehrh. Saxicolous, common.
14. *L. sulphurea*, Ach. Abundant and in fruit, especially about the shore. Saxicolous.
15. *L. badia*, Ach. Saxicolous.
16. *L. atra*, Ach. Saxicolous: abundant and in fruit, especially about the shore.
17. *Lecidea subepulotica*, Nyl. MS., not recorded in his 'Lich. Scand.' Subsequently, in a letter of January 25, 1866, he thus refers to it:—" *L. subepulotica*, Nyl. in litt. ad Tuck. et alios, n'est qu'une forme du *Lecanora epulotica*, Ach., du groupe du *cinerea*."
18. *L. coarctata*, Ach. Saxicolous: exactly resembling specimens growing on similar trappean rocks on Kinnoull Hill, Perth.
19. *L. parasema*, Ach. Saxicolous, common.
20. *L. contigua*, Fr., many varieties, including isidioid forms. Saxicolous, very abundant.
21. *L. atro-alba*, Flot. Saxicolous.
22. *L. petræa*, Flot. Saxicolous.
23. *L. excentrica*, Ach. Saxicolous.
24. *L. coniops*, Whlnb. (Nyl. Scand. 237), and forms. Saxicolous.
25. *Verrucaria æthiobola*, Whlnb. (a variety of *V. margacea*, Whlnb. in Nylander's 'Scand.' 272). Saxicolous.
26. *V. maura*, Whlnb. Saxicolous.

III. *Norway*.

1. *Pyrenopsis fuscatula*, Nyl. Enumér. 143. Saxicolous, Romsdal. Associated with *Lecidea geminata*, Flot.

2. *Collema pulposum*, Ach. Terricolous (among moss). Dr. Gilchrist.
3. *Sphærophoron coralloides*, Pers. Sneehätten: on the Dovrefjeld, generally rare, and not in fruit.
4. *Bæomyces placophyllus*, Ach. Quamsklar, Valderstift, 1851. Prof. Blytt.
5. *B. icmadophilus*, Ehrh. Terricolous, Sneehätten.
6. *Stereocaulon paschale*, Laur. Terricolous.
7. *S. tomentosum*, Laur. Dovrefjeld, frequently in fruit. As abundant as *Alectoria ochroleuca*, *Platysma nivale*, or *P. cucullatum*, and sometimes much more so than *Cladonia rangiferina*.
8. *Siphula ceratites*, Fr. Terricolous. Alsenö, Helgoland, Nordland, 1841, Blytt. The Kew Herbarium contains several Norwegian specimens, mostly from Sommerfelt (*e. g.* on the highest hill-tops of the island of Otterö, Nordland, Smrf. Un. It. 1828), sub nom. *Cenomyces ceratites*, Ach., and *Isidium dactylinum*, Ach.
9. *Thamnolia vermicularis*, L. Terricolous, Sneehätten, common; exactly like my Scotch specimens (from the Braemar and Breadalbane mountains).
10. *Usnea barbata*, Fr., various forms. Corticolous, rarely in fruit, but frequently sorediiferous; more or less abundant in the subalpine and lowland forests. On old rugged bark of birch, and on various firs in the forests of Guldbrandsdal; on spruce and larch about Christiania.
11. *Alectoria jubata*, Ach. Corticolous, common: on spruce, larch, Scotch fir, birch, and other trees in the forests of Guldbrandsdal.

Form *cana*, Ach. Corticolous, Vaage Vand, Loordal.

Form *chalybeiformis*, Ach. Saxicolous, common on the Haalangen- and Dovre-fjelds.

12. *A. ochroleuca*, Ehrh. Terricolous, sterile generally; very abundant on the Dovrefjeld. In fruit on the top of the Tettefjeld near Tofte (Dovrefjeld range); Smrf. Un. It. 1828, in Herbarium, Kew. Similar specimens in beautiful fruit have been sent me by Krempelhuber of Munich, from the Salzburg Alps (1863).
13. *Evernia prunastri*, Ach. Corticolous.
14. *Ramalina polymorpha*, Ach.

Var. *capitata*, Ach. (*R. tinctoria*, Schær. Exs. 394, Hepp, 563). Saxicolous, abundant on the Dovrefjeld.

15. *R. calicaris*, Fr., and vars. *fraxinea*, Fr., and *fastigiata*, Fr. Corticolous.
16. *R. pollinaria*, Ach.: indistinguishable, it seems to me, from forms of *R. polymorpha*, and saxicolous states of *R. calicaris*, var. *farinacea*, Ach. Such a form as var. *β. rupestris*, Flk., in Hepp's 'Exs.' 566, is doubtless confounded with, or properly merged in, *R. polymorpha*. All the forms, states, varieties, and species of Scandinavian, as well as British, *Ramalina* that I have seen, would be more conveniently, for the purposes of science, regarded, I think, as referable to a single protean species.
17. *Cetraria Islandica*, Ach., and its vars. *crispa*, Ach., *platyna*, Ach., and *Delisei*, Schær., with their transition forms. Dovrefjeld, Haalangenfjeld, and other mountain-ranges, abundant; fruiting frequently in the larger or broader forms (Fogstuen). Some years ago I examined a large quantity of the "Iceland Moss" of commerce (while engaged in the examination of the spermogones of this species): it had all the appearance of the specimens I gathered on the Dovrefjeld, on which the commercial moss is said to be chiefly collected for the London market. The larger forms (*e. g.* var. *platyna*) were frequently found in fruit.
18. *C. aculeata*, Ehrh. From Jerkin to the top of Sneehätten (4500 to 7500 feet).
19. *Platysma nivale*, L. Sneehätten and other mountains, very abundant, among moss; spermogoniferous and in fruit; exhibiting considerable variety as to colour, breadth of thallus, and curling of its edges.
20. *P. cucullatum*, Hffm. Sneehätten, and all the fjelds or mountain-ranges, very abundant; frequent in fruit, and also spermogoniferous; like the preceding as to breadth of thallus, colour, &c.
21. *P. sæpincolum*, Hffm. Corticolous. In the fir-woods of Guldbrandsdal; about Eidsvold, on the Mjösen (some forms large-lobed, with sorediiferous margins); in fruit, on pales, Guldbrandsdal, Smrf. U. I. 1828, in Herbarium Kew.
22. *P. ulophyllum*, Ach. Corticolous, on the Dovrefjeld, and in the mountain-valleys trending therefrom. Allied to the preceding, of which Acharius considered it a variety. Nylander describes it (Scand. 82) as "forte propria species."
23. *P. Fahlunense*, L. Saxicolous: common on the Dovre- and Haalangen-fjelds; frequently in fruit, and spermogoniferous.

24. *P. juniperinum*, L. Corticolous and saxicolous (on twigs of shrubs and on boulders), Dovrefjeld and Guldbrandsdal. Frequently in fruit, and spermogoniferous.

25. *P. pinastri*, Seop. Equally abundant in the same loealities and habitats as the preceding, to whieh it is allied, if it is not a mere form thereof. Oeeurs also on weathered timber.

26. *P. glaucum*, L. Cortieolous, saxicolous, and terrieolous, common. In the fir-woods of Guldbrandsdal; on trunks of pines about Christiania, Smrf. U. I. 1828, in Herbarium Kew; Vaage Vand, on boulders or on the ground among mosses, &c.

Form *fallax*, Ach. On ash about Christiania.

27. *Nephromium tomentosum*, Hffm. Jerkin.

28. *N. lævigatum*, Aeh., various forms. Cortieolous, in the fir-woods of Guldbrandsdal. Saxicolous, Haalangenfjeld, Romsdal, and Vaage Vand.

29. *Peltigera aphthosa*, Hffm. Terrieolous and museicolous, common on the Dovrefjeld.

30. *P. malacea*, Fr. Apt to be confounded with *P. horizontalis*.

31. *P. canina*, Hffm., in various forms; common. Romsdal; Christiansand.

32. *P. horizontalis*, Hffm. Romsdal; Jerkin. Common.

33. *Solorina crocea*, L. Terricolous, Haalangenfjeld; abundant and in fruit about the glacier at Fogstuen.

34. *Stictina scrobiculata*, Seop. Cortieolous, Romsdal.

35. *Sticta pulmonacea*, Ach. Cortieolous, Vaage Vand.

36. *Parmelia tiliacea*, Ach., form *lævigata*, Aeh. Cortieolous (on ash), about Christiania: elosely resembling form *leucochroa*, Wallr., of *Parmelia saxatilis*.

Form *scortea*, Aeh. Saxieolous (on boulders), about Christiania.

37. *P. saxatilis*, Aeh., with its forms *leucochroa*, Wallr., and *furfuracea*, Sehær., and its oehraeeous and whitish eonditions with all their transition states. Cortieolous forms are generally, as with us, light-coloured, large-lobed, and smoothish: eommon on bireh bark, espeeially where it is old and craeked, as well as on various firs or pines in the forests of Guldbrandsdal and Romsdal. Saxicolous forms are, on the other hand, more generally dark-eoloured or ochraeeous, small-lobed, and furfuraeeous: on boulders about Christiania, and on all the mountain-ranges. Seldom fertile, espeeially the eortieolous forms; frequently, however, in all its conditions of thallus, spermogoniferous.

Var. *omphalodes*, Ach. Saxicolous; sometimes with a peculiar bluish bloom on the blackish-brown glistening thallus.

Var. *panniformis*, Ach. Saxicolous. With the former variety, montane or alpine.

38. *P. conspersa*, Ach. Saxicolous and corticolous; very common; very variable, especially as to the colour and size of the thalline laciniæ; frequently in fruit and spermogoniferous. On walls, Romsdal; on boulders about Christiania; on junipers, Dovrefjeld. Passes apparently into the following.

39. *P. centrifuga*, Ach. Saxicolous and corticolous (Fogstuen); terricolous (Sneehätten); frequently in fruit, and spermogoniferous. Perhaps even more abundant than the preceding, to which it appears to me to be really referable. Its apothecia and spores are essentially the same as those of *P. conspersa*; while the only difference is in the size and division of the thalline laciniæ. *P. centrifuga*, however, seems a more alpine and northern form than *P. conspersa*.

40. *P. olivacea*, Ach. Corticolous and saxicolous, common. On old cracked bark of birch, and on fir branches, in the forests of Guldbrandsdal; on ash, and also on boulders, about Christiania.

41. *P. exasperata*, Ach. Occurs in the same localities and habitats as the preceding, of which I consider it a variety. Both are frequent in fruit.

42. *P. stygia*, Ach. Saxicolous, common on the Dovrefjeld: in fruit.

43. *P. lanata*, L. Saxicolous, common on the Dovre- and Haalangen-fjelds: both sterile and in fruit. Some forms are extremely like certain saxicolous states of *Alectoria jubata* (form *chalybeiformis*), with which it is apt to be confounded in herbaria.

44. *P. physodes*, Ach. Corticolous and saxicolous: frequently spermogoniferous, rarely bearing apothecia. Common on fir branches in the forests of Guldbrandsdal.

Var. *obscurata*, Ach. (Hepp, Exs. 585), Haalangenfjeld. In the Herbarium Kew, there is a Norwegian specimen from Sommerfelt, Un. It. 1828, as deeply bronzed as *P. olivacea*, which it much resembles.

Var. *vittata*, Ach.

Var. *labrosa*, Ach.

Are more or less plentiful in the mountain-valleys.

45. *P. encausta*, Sm. Saxicolous, common on the Haalangenfjeld; frequently in fruit and spermogoniferous; varies much as to the colour and size of the thalline laciniæ.

46. *P. arctica*, Th. Fr. Saxicolous, top of Sneehätten. Not mentioned in Nylander's 'Scand.'

47. *Parmeliopsis ambigua*, Ach. Corticolous (on weathered wood), Fogstuen, common.

48. *P. aleurites*, Ach. Corticolous (on weathered wood), Jerkin. Not *Lichen aleurites*, Sm. (E. Bot. t. 858), which is *Parmelia placorodia*, Ach. (*fide* Nyl. Scand. 106).

49. *Physcia parietina*, L. Corticolous and saxicolous, common. On old cracked bark of birch in the forests of Guldbrandsdal; on ash about Christiania; on walls, Romsdal.

Var. *polycarpa*, Ehrh. Corticolous; common on pine- and fir-twigs, living and dead, Eidsvold (Mjösen lake).

50. *P. lychnea*, Ach. Corticolous and saxicolous, on old rugged bark of birch in the forests of Guldbrandsdal; on walls and boulders, Jerkin.

51. *P. candelaria*, Ach. pr. p., Nyl. (*Lichen concolor*, Dicks.). Saxicolous. Frequently associated with *Lecanora vitellina*: very common on boulders, Jerkin; on walls, Romsdal.

52. *P. pulverulenta*, Fr. Corticolous, common about Eidsvold; on old rugged bark of birch in the forests of Guldbrandsdal; on ash about Christiania. Thallus sometimes very white pruinose.

53. *P. muscigena*, Whlnb. Terricolous; Sneehätten, and the Dovrefjeld generally, common; a variety of the preceding, according to Nylander's 'Scand.' 110.

54. *P. aquila*, Ach. Saxicolous, Christiansand.

55. *P. stellaris*, Fr. Corticolous, saxicolous, terricolous, and muscicolous; in some of its most variable forms, common; frequently in fruit, and spermogoniferous. On old rugged bark of birch in the forests of Guldbrandsdal; on ash about Christiania.

Var. *subobscura*, Nyl. Corticolous (on weathered wood), and muscicolous, Jerkin.

Var. *leptalea*, Ach.

Var. *tenella*, Scop.

Var. *aipolia*, Ach.

Subform *acrita*, Ach.

56. *P. cæsia*, Hffm. Saxicolous, common, frequently accompanying *Placodium elegans*. On walls, Romsdal; on boulders about Christiania.

57. *P. obscura*, Fr. Corticolous, saxicolous (Laurgaard), and muscicolous (Romsdal).

58. *Umbilicaria pustulata*, Hffm. Abundant and in large beautiful

specimens about Christiansand: the "Pustulatous Moss" of commerce, formerly largely collected in Norway for the London orchil-market; frequently spermogoniferous.

59. *U. atro-pruinosa*, Schær. Haalangenfjeld, common.

60. *U. vellea*, Ach. Top of Sneehätten; Haalangenfjeld, common: closely allied to the following; abundantly fructiferous; thallus sometimes a foot in diameter.

61. *U. spodochroa*, Hffm. (including as a var. *U. depressa*, Ach.; Schær. Exs. 137–140). Christiansand, abundant: the largest and most plentiful of all the Norwegian *Umbilicariæ*; frequent in fruit and spermogoniferous. The "Velutous Moss" of commerce; at one time largely imported from Norway, and used in the manufacture in this country of orchil and cudbear, for which now only the *Roccellæ* are employed.

62. *U. hirsuta*, Ach. Sneehätten.

63. *U. proboscidea*, DC. (*U. varia*, var. *deusta*, Leighton, Umbil. 17). Sneehätten; Haalangenfjeld: very common.

64. *U. cylindrica*, Dub. Dovrefjeld, common, frequently spermogoniferous. Includes a form which Schærer calls *nudiuscula* (Exs. 145), in which the cortical layer of the thallus is eroded, exposing in irregular patches the subjacent white medullary tissue.

65. *U. erosa*, Hffm. Common on the Haalangen- and Dovre-fjelds. Sommerfelt's *Gyrophora glabra*, Ach., in the Herbarium Kew, from Mount Johnsknuden, near Kongsberg, U. I. 1828, is apparently referable here.

66. *U. hyperborea*, Hffm. Laurgaard; Alps of Lapland, Solander, in Herbarium British Museum. Sommerfelt's Dovrefjeld specimens in the Herbarium Kew, have *simple* apothecia, and the thalline surface is not much blistered. His *Gyrophora tessellata*, Ach., in the Herbarium Kew, also from the Dovrefjeld, seems partly referable here, partly to *U. atro-pruinosa*. Another Norwegian specimen in the Herbarium Kew is very large, nearly a foot in diameter.

67. *U. flocculosa*, Hffm. Jerkin.

68. *U. polyphylla*, Schrad. Common on the Dovre- and Haalangen-fjelds.

69. *U. stipitata*, Nyl. Scand. 289. *In fruit* (simple lecidine apothecia). The only specimen recorded in Nylander's 'Scand.' is from the Rundanefjeld, Norway, collected by Zetterstedt; but it was *sterile*.

All the *Umbilicariæ* are saxicolous.

70. *Psoroma hypnorum*, Hffm. Terricolous and muscicolous, Haalangenfjeld.

71. *Pannaria leucolepis*, Whlnb. (*Lichen Hookeri*, Sm. E. Bot. t. 2283). Lom, Prof. Blytt.

72. *Squamaria cartilaginea*, DC. (*fide* Blytt). Nysterö, Christianiafjord, 1855; probably confounded with *S. straminea* and *S. saxicola*.

73. *S. saxicola*, Pollich. Saxicolous, common on Sneehätten and the Dovrefjeld generally; on walls, Romsdal. To its var. *versicolor*, Pers., appears to be referable *Lecanora Sommerfeltiana*, Flk. in Herb. Blytt; saxicolous, Kongsvold and Drivdal, Dovrefjeld.

74. *S. straminea*, Whlnb. (*fide* Blytt). Nordland.

75. *S. gelida*, L. Saxicolous, on boulders, Romsdal; Drivdal, Dovrefjeld, Blytt.

76. *Placodium murorum*, Hffm. Saxicolous, common. On walls, Romsdal.

Var. *miniatum*, Hffm., is with difficulty distinguishable from forms of the following.

77. *P. elegans*, DC. Saxicolous, terricolous, and muscicolous: abundant about Jerkin; on walls, Romsdal.

78. *P. fulgens*, DC. (*fide* Blytt). Drivdal, Dovrefjeld.

79. *P. bracteatum*, Hffm. Terricolous: Kongsvold, Blytt.

80. *Lecanora vitellina*, Ach. Saxicolous, corticolous (on twigs of shrubs), and terricolous: abundant about Jerkin.

81. *L. aurantiaca*, Lightf. Corticolous, Eidsvold; on ash about Christiania.

82. *L. ferruginea*, Huds. Saxicolous, common: Guldbrandsdal.

Form *festiva*, Ach. Saxicolous, Jerkin.

83. *L. cerina*, Ehrh. Corticolous (on twigs of shrubs, on old barks of trees, and on weathered timber), terricolous, and muscicolous: very common on the Dovrefjeld, and in its valleys. A Dovrefjeld specimen in the Herbarium Kew, from Sommerfelt, U. I. 1828, has large, convex, much crowded apothecia, with a disappearing border.

84. *L. pyracea*, Ach. Corticolous, Romsdal.

85. *L. fulvo-lutea*, Nyl. Terricolous and muscicolous, Jerkin.

86. *L. oreina*, Ach. (*fide* Blytt). Drivstuen, Dovrefjeld. Saxicolous (on loose stones around the station-house).

87. *L. sinapisperma*, DC. Muscicolous and terricolous, Lillehaave. Referred by Nylander (L. Scand. 146) to *L. leucoræa*, Ach.

88. *L. nimbosa*, Fr. Terricolous, Fogstuen.

89. *L. sophodes*, Ach., and var. *lævigata*, Ach. Terricolous, Fogstuen; Laurgaard.

90. *L. turfacea*, Whlnb., and var. *mniaræa*, Ach. Terricolous and muscicolous, Dovre- and Haalangen-fjelds, common.

91. *L. cinerea*, L., including several forms more or less well marked. Saxicolous, abundant on, or in, all the mountain-ranges and valleys; one of the most common, as well as puzzling, subalpine Norwegian *Lecanoræ*.

92. *L. cinereo-rufescens*, Ach.* Saxicolous, Haalangenfjeld. Closely allied to, if not a form of, the preceding.

93. *L. pelobotrya*, Smrf. Mountains of Stördal, Trondhjemstift, 1824, Blytt. Also allied to *L. cinerea*.

94. *L. verrucosa*, Laur. Terricolous and muscicolous: associated frequently with *Pertusaria glomerata*: Sneehätten and Jerkin.

95. *L. parella*, Ach. Saxicolous and muscicolous: common, in some of its forms, on the Dovrefjeld.

Var. *pallescens*, Ach. Hvitingsö, Stavanger, coll. Schubeler in Herb. Blytt. A common Scotch saxicolous form.

Var. *Upsaliensis*, Ach. The common montane or alpine muscicolous form.

96. *L. tartarea*, Ach. Saxicolous, terricolous, muscicolous, and corticolous (on twigs and roots of shrubs): very common, in some of its forms, on Sneehätten and the Dovrefjeld.

Var. *frigida*, Sm., the common muscicolous montane form, is generally more abundant than the type.

Var. *gonatodes*, Ach., in the Herbarium Kew, from the summits of the Dovrefjeld (Smrf. U. I. 1828), is simply a condition of var. *frigida*.

97. *L. glaucoma*, Ach. Saxicolous, common on all the mountain-ranges.

98. *L. subfusca*, Ach. Corticolous, muscicolous, and saxicolous: common on ash about Christiania; on decayed mosses, shrubs, &c., Jerkin.

Var. *epibrya*, Ach. Terricolous and muscicolous, common on the mountain-ranges.

Var. *argentata*, Ach. Corticolous (on weathered wood and bark), Haalangenfjeld.

Var. *atrynea*, Ach. ("atypica substrato alieno superveniens," Nylander notes on my specimen). Saxicolous: Kongsvold and Jerkin, common.

* In a letter (of date July 18, 1866) Nylander refers this to *L. cinerea*, L., var. *alpina*, Smrf.

Var. *glabrata*, Ach. On weathered fabricated timber, Romsdal. Referred to variety *argentata* by Nylander (L. Scand. 160).

Var. *coilocarpa*, Ach. Saxicolous and corticolous (old barks of trees): Jerkin, common.

99. *L. cenisia*, Ach. Saxicolous, terricolous, and muscicolous, Kongsvold and Jerkin. Referred by Nylander (L. Scand. 161) to var. *atrynea* of the preceding.

100. *L. umbrina*, Ach. Saxicolous, Jerkin. Allied to *L. subfusca.*

101. *L. varia*, Ach. Corticolous (on fabricated, weathered wood), very common, Vaage Vand and Guldbrandsdal.

Var. *intricata*, Ach. Saxicolous, Haalangenfjeld; associated with the following variety. In the Herbarium Kew there is a Sneehätten specimen, from Sommerfelt (U. I. 1828), which is terricolous and muscicolous, and appears to be his form *leptacina*. There is scarcely any thallus; and the apothecia are bluish, and pruinose or bloom-covered.

Var. *polytropa*, Ehrh. Saxicolous, very common, top of Sneehätten; on walls, Romsdal. To this seems to be referable (pr. p. at least) Blytt's *L. Ehrhartiana*: saxicolous, Kongsvold.

Var. *hypopta*, Ach. Corticolous (on weathered, fallen, and drift wood), Væblungsnæset, Romsdal.

102. *L. argopholis*, Whlnb. Saxicolous, common about Jerkin and Kongsvold.

Var. *thiodes*, Sprengel, terricolous and saxicolous, Kongsvold, 1854, Blytt, sub nom. *L. frustulosa* and its var. *Blyttii* (Hepp, Exs. 178), appears to me but a variety with a white thallus. *L. argopholis* is at least closely allied to the following, with which it would appear for the most part to have been confounded in the herbarium of Blytt.

103. *L. frustulosa*, Dicks. (*fide* Blytt). Drivdal, Dovrefjeld.

104. *L. atro-sulphurea*, Whlnb. (*fide* Blytt). Nordland.

105. *L. epanora*, Ach. Saxicolous: Christiania, 1856, Blytt.

106. *L. nephæa*, Smrf. (*fide* Blytt). Drivdal, Dovrefjeld.

107. *L. badia*, Ach. Saxicolous, very common on the Haalangen- and Dovre-fjelds.

Var. *cinerascens*, Nyl. Saxicolous, Jerkin and Fogstuen.

108. *L. atra*, Ach. Saxicolous, common: Dovrefjeld; Guldbrandsdal; on talcose slate, Hvitingsö; Stavanger, July 1854, coll. Schubeler in Herb. Blytt. Very like British specimens on marine rocks (Jersey, &c.).

109. *L. ventosa*, Ach. Saxicolous, common, Dovrefjeld.

110. *L. chlorophana*, Whlnb. Saxicolous, Jerkin.

111. *L. molybdina*, Whlnb. (*fide* Blytt). Nordland.
112. *L. glaucocarpa*, Whlnb. Saxicolous, Kongsvold, Blytt. Allied to, if not a form of, *L. cervina*, Ach.
113. *L. fuscata*, Schrad. (*Lecidea rufescens*, Borr. E. Bot. Suppl. t. 2657). Saxicolous: Jerkin; Lillehaave. Also allied to, or a form of, *L. cervina*.
   Var. *smaragdula*, Whlnb. Saxicolous; on walls, Romsdal.
114. *L. peliscypha*, Whlnb. Saxicolous, Jerkin and Lillehaave. Like the two preceding, probably referable to *L. cervina*, Nyl. Scand. 175.
115. *Urceolaria scruposa*, Ach. Saxicolous, Christiania, Jerkin, and Fogstuen.
   Var. *bryophila*, Ach. Terricolous and muscicolous, Romsdal.
116. *Pertusaria multipuncta*, Turn. (Sm. E. Bot. t. 2061), var. *leucotera*, Nyl. Terricolous, Jerkin.
117. *P. glomerata*, Ach. Terricolous and muscicolous, Jerkin and Fogstuen.
118. *Varicellaria microsticta*. Nyl. Terricolous and muscicolous, Jerkin.
119. *Lecidea pineti*, Ach. Muscicolous, Haalangenfjeld.
120. *L. decolorans*, Flk. Terricolous, common, Jerkin and Fogstuen.
121. *L. atro-rufa*, Ach. Terricolous, very common on the Dovrefjeld and Haalangenfjeld; Sneehätten.
122. *L. vernalis*, Ach. Terricolous and muscicolous, Haalangenfjeld. Sub nom. *L. sphæroides*, Smrf., in the Herbarium Kew, on decayed mosses, &c., and near Christiania, Smrf. U. I. 1828.
123. *L. turgidula*, Fr., form *pallida*, Nyl. ("varians apotheciis pallidis," MS., and Scand. 201). Corticolous: Vaage Vand; Guldbrandsdal. Allied to, if not a form of, the preceding.
124. *L. pezizoidea*, Ach. Terricolous and muscicolous, Fogstuen.
125. *L. candida*, Ach. Terricolous and muscicolous, Kongsvold, Blytt. Like my Kinnoull-Hill (Perth) specimens.
126. *L. parasema*, Ach. Corticolous (on the generally smooth bark of living trees, and on palings), very common in some of its many forms: Christiania; Romsdal. Terricolous, Jerkin.
   Form *rugulosa*, Ach. On living bark, Eidsvold; saxicolous, common on the Dovrefjeld.
   Var. *enteroleuca*, Ach. Corticolous (on weathered and rotting timber and bark, as well as on living trees): in the fir-forests of Guldbrandsdal; on alder, Eidsvold; on ash about Christiania. Saxicolous, Jerkin.

Var. *monticola*, Ach. Saxicolous, Fogstuen. Referred by Nylander to var. *nitidula*, Fr., L. Scand. 217.

127. *L. stenotera*, Nyl. Terricolous, Fogstuen. Allied to *L. Dovrensis*, Nyl., which, curiously enough, does not appear in my collection, notwithstanding that Nylander describes it (L. Scand. 221) as "in Alpe Dovre Norvegiæ *frequens*, ut videtur." Possibly this may be accounted for by various other terricolous *Lecideæ* being confounded with it by Scandinavian lichenologists.

128. *L. assimilata*, Nyl. Terricolous, Fogstuen.

129. *L. contigua*, Fr., various forms. Saxicolous, very common on the mountains and in the mountain-valleys: top of Sneehätten; Haalangenfjeld.

Form *crustulata*, Ach. Saxicolous, Fogstuen. Referred by Nylander (L. Scand. 225) to his var. *meiospora*.

130. *L. lapicida*, Fr., var. *declinans*, Nyl. Saxicolous, Jerkin. Quite comparable with specimens I collected in Otago, New Zealand,

Subform *ecrustacea*, Nyl. (MS. note on my specimen). Saxicolous: Haalangenfjeld; Jerkin.

131. *L. polycarpa*, Flk. Saxicolous, Laurgaard.

132. *L. lithophila*, Ach. Saxicolous, Jerkin: in some of its forms or varieties very common.

Form *ecrustacea* (Nyl. MS. on my specimen). Saxicolous, top of Sneehätten.

Var. *pallido-cinerea*, Flk. Saxicolous, Christiania.

133. *L. tessellata*, Flk. Saxicolous, Haalangenfjeld, with the two preceding, allied to, or forms of, *L. lapicida*.

134. *L. amylacea*, Ach. (*fide* Blytt). Kongsvold; probably confounded with *L. farinosa*, Ach., to which is also perhaps referable Blytt's *Lecanora Myreni*, named after Dr. Myren, a Swedish botanist. Saxicolous, foot of Sneehätten, 1854.

135. *L. aglæa*, Smrf. (*fide* Blytt). Drivdal, Dovrefjeld.

136. *L. fusco-atra*, Ach. Saxicolous: Lillehaave, Dovrefjeld, and Haalangenfjeld, common.

137. *L. lactea*, Flk.

Form *hypothallina* (Nyl. MS. on my specimen). Saxicolous, Haalangenfjeld.

138. *L. atro-alba*, Flot. Saxicolous: top of Sneehätten; Dovrefjeld; Romsdal: common.

139. *L. petræa*, Flot. Saxicolous: Lillehaave; Haalangenfjeld; on walls, Romsdal.

140. *L. geminata*, Flot. Saxicolous, Romsdal.

141. *L. albo-atra*, Hffm. Saxicolous: Kongsvold, Blytt.

Var. *epipolia*, Ach., Nyl. L. Scand. 236 (*Lichen speireus*, Sm. E. Bot. t. 1138; *Lecidea margaritacea*, Smrf.). Saxicolous: Kongsvold, Blytt.

142. *L. disciformis*, Fr. Corticolous (on smooth bark of living trees), Romsdal; on alder, Eidsvold. Muscicolous and terricolous: Laurgaard; Fogstuen.

Var. *insignis*, Næg. (*Lecidea*, Hepp, Exs. 39). Terricolous and muscicolous, Fogstuen and Jerkin. Not mentioned in Nylander's 'L. Scand.'

143. *L. myriocarpa*, DC. Corticolous (on weathered, fallen, or fabricated wood): Romsdal; Jerkin.

144. *L. saxatilis*, Schær. Saxicolous, Jerkin.

145. *L. xanthococca*, Smrf., form *ecrustacea* (Nyl. MS. on my specimen). Corticolous (on weathered fabricated timber), Vaage Vand and Guldbrandsdal.

146. *L. sanguinaria*, Ach. Terricolous, Vaage Vand.

147. *L. galbula*, Ram. (*fide* Blytt). Saxicolous, on cliffs on the highest part of the old road over the Dovrefjeld, called "the Vorsti."

148. *L. alpicola*, Schær. Saxicolous, top of Sneehätten.

149. *L. geographica*, Schær. Saxicolous: Christiansand; Dovrefjeld; very common on boulders about Christiania; in various forms on or in all mountains and mountain-valleys; especially abundant on light-coloured gneiss and quartz rock.

150. *L. citrinella*, Ach. (*fide* Blytt). Rondfjeld; Guldbrandsdal.

151. *L. Diapensiæ*, Th. Fr. On cushions of dwarf phænogams, (*e. g.* weathered basal leaves of *Diapensia lapponica*, L.), moss, &c., top of Sneehätten. Not mentioned in Nylander's 'L. Scand.'

152. *L. Berengeriana*, Mass. (*Biatora Berengeriana*, Mass. Ric. p. 128). Terricolous and muscicolous, Jerkin. Not mentioned in Nylander's 'L. Scand.'

153. *Graphis scripta*, Ach. Corticolous (on smooth bark of living trees, especially alder), Eidsvold.

154. *Arthonia astroidea*, Ach. Corticolous (on smooth bark of living trees), Romsdal.

155. *A. varians*, Dav. Parasitic on the apothecia of *Lecanora glaucoma*: Jerkin.

156. *Endocarpon miniatum*, Ach. Christiansand, saxicolous; exactly like my specimens from Stenton Crag, Dunkeld.

157. *Verrucaria epidermidis*, Ach. (var. *grisea*, Schær.). Corticolous: (on living bark) Fogstuen; (on old rugged bark of birch) Guldbrandsdal.

Tabular Summary *.

† indicates species and varieties which are *not British.*

Tribe.	Genus.	Species and variety.	Iceland.		Färö.		Norway.	
			Species.	Varieties.	Species.	Varieties.	Species.	Varieties.
I. Lichinei	1. Ephebe	1. pubescens, *Fr.*	*					
	2. Lichina	2. confinis, *Ag.*	*					
II. Collemei ...	3. Pyrenopsis....	† 3. hæmatopis, *Smrf.*	*					
		† 4. fuscatula, *Nyl.*	..	..	..	..	*	
	4. Collema	5. pulposum, *Ach.*	..	..	..	..	*	
III. Sphærophorei	5. Sphærophoron .	6. coralloides, *Pers.*	*	..	..	..	*	
IV. Bæomycei ..	6. Bæomyces	7. placophyllus, *Ach.*	..	..	..	..	*	
		8. icmadophilus, *Ehrh.*	..	..	..	..	*	
V. Stereocaulei .	7. Stereocaulon ..	9. paschale, *Laur.*	*	..	..	..	*	
		10. tomentosum, *Laur.*	..	..	..	..	*	
		11. denudatum, *Flk.*	*					
		12. condensatum, *Hffm.*	*					
VI. Siphulei	8. Siphula	†13. ceratites, *Fr.*	..	..	..	..	*	
	9. Thamnolia....	14. vermicularis, *L.*	..	..	..	..	*	
VII. Usneei	10. Usnea........	15. barbata, *Fr.*	..	..	..	.	*	
		1. var. ceratina, *Ach.*	..	*				
VIII. Ramalinei ..	11. Alectoria	16. jubata, *Ach.*	..	..	..	..	*	
		2. form cana, *Ach.*	..	..	..	..	..	*
		3. form chalybeiformis, *Ach.*	..	..	..	..	..	*
		17. ochroleuca, *Ehrh.*	..	..	..	..	*	
	12. Evernia	18. prunastri, *Ach.*	..	..	..	..	*	
	13. Ramalina	19. scopulorum, *Ach.*	*	..	*			
		20. polymorpha, *Ach.*						
		4. var. capitata, *Ach.*	..	*	..	..	..	*
		21. calicaris, *Fr.*	..	..	..	..	*	
		5. var. fraxinea, *Fr.*	..	..	..	..	..	*
		6. var. fastigiata, *Fr.*	..	..	..	..	..	*
		22. pollinaria, *Ach.*	..	..	..	..	*	
IX. Cetrariei	14. Cetraria	23. Islandica, *Ach.*	*	..	*	..	*	
		7. var. crispa, *Ach.*	..	*	..	*	..	*
		8. var. platyna, *Ach.*	..	..	..	..	..	*
		9. var. Delisci, *Schær.*	..	..	..	..	..	*
		24. aculeata, *Ehrh.*	*	..	*	..	*	
		10. var. muricata, *Ach.*	..	*	..	*		
	15. Platysma	25. nivale, *L.*	*	..	..	..	*	
		26. cucullatum, *Hffm.*	*	..	..	..	*	
		27. sæpincolum, *Hffm.*	..	..	..	..	*	
		†28. ulophyllum, *Ach.*	..	..	..	..	*	
		29. Fahlunense, *L.*	.	..	..	..	*	
		30. juniperinum, *L.*	..	..	..	..	*	
		31. pinastri, *Scop.*	..	..	..	..	*	
		32. glaucum, *L.*	..	..	..	..	*	

* The *Cladoniæ* collected in Iceland, Färö, and Norway are unavoidably omitted: and all my lists are necessarily, to that extent, defective.

Tribe.	Genus.	Species and variety.	Iceland.		Färö.		Norway.	
			Species.	Varieties.	Species.	Varieties.	Species.	Varieties.
	15. Platysma	(32.) 11. form fallax, *Ach.*	..	..	..	..	..	*
X. Peltigerei ..	16. Nephromium ..	33. tomentosum, *Hffm.*	..	..	..	..	*	
		34. lævigatum, *Ach.*	..	..	..	..	*	
	17. Peltigera	35. aphthosa, *Hffm.*	..	..	..	..	*	
		†36. malacea, *Fr.*	..	..	..	..	*	
		37. canina, *Hffm.*	*	..	..	..	*	
		38. horizontalis, *Hffm.*	..	..	..	..	*	
	18. Solorina	39. crocea, *L.*	..	..	..	..	*	
XI. Parmeliei ..	19. Stictina	40. scrobiculata, *Scop.*	..	..	..	..	*	
	20. Sticta	41. pulmonacea, *Ach.*	..	..	..	..	*	
	21. Parmelia	42. tiliacea, *Ach.*						
		12. form lævigata, *Ach.*	..	..	..	..	..	*
		13. form scortea, *Ach.*	..	..	..	..	..	*
		43. saxatilis, *Ach.*	*	..	*	..	*	
		14. form leucochroa, *Wallr.*	..	..	..	..	..	*
		15. form furfuracea, *Schær.*	..	..	..	..	..	*
		16. var. omphalodes, *Ach.*	..	*	..	..	..	*
		†17. var. panniformis, *Ach.*	..	..	..	..	..	*
		44. conspersa, *Ach.*	..	..	..	..	*	
		†45. centrifuga, *Ach.*	..	..	..	..	*	
		46. olivacea, *Ach.*	..	..	..	..	*	
		47. exasperata, *Ach.*	..	..	..	..	*	
		48. stygia, *Ach.*	..	..	..	..	*	
		49. lanata, *L.*	*	..	..	..	*	
		50. physodes, *Ach.*	..	..	..	..	*	
		18. var. vittata, *Ach.*	..	..	..	..	..	*
		†19. var. obscurata, *Ach.*	..	..	..	..	..	*
		20. var. labrosa, *Ach.*	..	..	..	..	..	*
		51. encausta, *Ach.*	..	..	..	..	*	
		†52. arctica, *Th. Fr.*	..	..	..	..	*	
	22. Parmeliopsis ..	53. ambigua, *Ach.*	..	..	..	..	*	
		54. aleurites, *Ach.*	..	..	..	..	*	
	23. Physcia	55. parietina, *L.*	*	..	*	..	*	
		21. var. polycarpa, *Ehrh.*	..	..	..	..	..	*
		56. lychnea, *Ach.*	..	..	..	..	*	
		57. candelaria, *Ach.*	..	..	..	..	*	
		58. pulverulenta, *Fr.*	..	..	..	..	*	
		59. muscigena, *Whlnb.*	..	..	..	..	*	
		60. aquila, *Ach.*	..	..	..	..	*	
		61. stellaris, *Fr.*	..	..	..	..	*	
		†22. var. subobscura, *Nyl.*	..	..	..	..	..	*
		23. var. leptalea, *Ach.*	..	*	..	..	..	*
		24. var. tenella, *Scop.*	..	*	..	..	..	*
		25. var. aipolia, *Ach.*	..	..	..	..	..	*
		†26. subform acrita, *Ach.*	..	*	..	..	..	*
		62. cæsia, *Hffm.*	*	..	..	..	*	
XII. Gyrophorei .	24. Umbilicaria ..	63. obscura, *Fr.*	..	..	..	..	*	
		64. pustulata, *Hffm.*	..	..	..	..	*	
		†65. atro-pruinosa, *Schær.*	..	..	..	..	*	
		66. vellea, *Ach.*	..	..	..	..	*	
		†67. spodochroa, *Hffm.*	..	..	..	..	*	
		†27. var. depressa, *Ach.*	..	..	..	..	..	*
		†68. hirsuta, *Ach.*	..	..	..	..	*	
		69. proboscidea, *DC.*	*	..	..	..	*	

Tribe.	Genus.	Species and variety.	Iceland. Species.	Iceland. Varieties.	Färö. Species.	Färö. Varieties.	Norway. Species.	Norway. Varieties.
	24. Umbilicaria ..	70. cylindrica, *Dub.*	*	..	..	..	*	
		28. form nudiuscula, *Schær.*	..	..	..	..	..	*
		71. erosa, *Hffm.*	*	..	..	..	*	
		72. hyperborea, *Hffm.*	..	..	..	..	*	
		73. flocculosa, *Hffm.*	..	..	..	..	*	
		74. polyphylla, *Schrad.*	..	..	..	..	*	
		†75. stipitata, *Nyl.*	..	..	..	..	*	
XIII. Lecanorei ..	25. Psoroma	76. hypnorum, *Hffm.*	..	..	..	..	*	
	26. Pannaria	77. leucolepis, *Whlnb.*	..	..	..	..	*	
		78. brunnea, *Mass.*	*					
	27. Squamaria	79. cartilaginea, *DC.*	*	..	..	..	*	
		80. saxicola, *Pollich*	*	..	..	..	*	
		†29. var. versicolor, *Pers.*	..	..	..	..	..	*
		†81. straminea, *Ach.*	*	..	..	..	*	
		82. gelida, *Sm.*	*	..	..	..	*	
	28. Placodium	83. murorum, *Hffm.*	*	..	..	..	*	
		30. var. miniatum, *Hffm.*	..	..	..	..	..	*
		84. citrinum, *Ach.*	*					
		85. elegans, *DC.*	..	..	..	..	*	
		86. fulgens, *DC.*	..	..	..	..	*	
		†87. bracteatum, *Hffm.*	..	..	..	..	*	
	29. Lecanora	88. vitellina, *Ach.*	*	..	*	..	*	
		89. aurantiaca, *Lightf.*	..	..	..	..	*	
		31. var. erythrella, *Ach.*	..	*				
		90. ferruginea, *Huds.*	..	..	..	..	*	
		32. form festiva, *Ach.*	..	..	..	..	..	*
		91. cerina, *Ach.*	*	..	..	..	*	
		92. pyracea, *Ach.*	..	..	..	..	*	
		†93. fulvo-lutea, *Nyl.*	..	..	..	..	*	
		†94. oreina, *Ach.*	..	..	..	..	*	
		†95. sinapisperma, *DC.*	..	..	..	..	*	
		†96. nimbosa, *Fr.*	..	..	..	..	*	
		97. sophodes, *Ach.*	*	..	..	..	*	
		†33. var. lævigata, *Ach.*	..	*	..	..	..	*
		†98. turfacea, *Whlnb.*	..	..	..	..	*	
		†34. var. mniaræa, *Ach.*	..	..	..	..	..	*
		99. cinerea, *L.*	*	..	*	..	*	
		100. cinereo-rufescens, *Ach.*	..	..	..	..	*	
		101. Dicksonii, *Ach.*	*					
		102. pelobotrya, *Smrf.*	..	..	..	..	*	
		103. verrucosa, *Laur.*	..	..	..	..	*	
		104. parella, *Ach.*	*	..	*	..	*	
		35. var. pallescens, *Ach.*	..	..	..	*	..	*
		36. var. Upsaliensis, *Ach.*	..	*	..	..	..	*
		105. tartarea, *Ach.*	..	..	*	..	*	
		37. var. frigida, *Sm.*	..	*	..	..	..	*
		38. var. gonatodes, *Ach.*	..	..	..	..	..	*
		†106. poliophæa, *Whlnb.*	*					
		107. glaucoma, *Ach.*	..	..	..	..	*	
		108. subfusca, *Ach.*	*	..	..	..	*	
		39. var. epibrya, *Ach.*	..	*	..	..	..	*
		40. var. argentata, *Ach.*	..	..	..	..	..	*
		41. var. atrynea, *Ach.*	..	..	..	..	..	*
		42. var. glabrata, *Ach.*	..	..	..	..	..	*

Tribe.	Genus.	Species and variety.	Iceland.		Färö.		Norway.	
			Species.	Varieties.	Species.	Varieties.	Species.	Varieties.
	29. Lecanora	(108.) †43. var. coilocarpa, *Ach.* ..	..	..	..	..	..	*
		†109. cenisia, *Ach.*	..	..	..	..	*	
		110. umbrina, *Ach.*	*	..	..	..	*	
		111. varia, *Ach.*................	..	..	..	..	*	
		44. var. intricata, *Ach.*	..	*	..	..	..	*
		45. subform leptacina, *Smrf.*	..	..	..	..	..	*
		46. var. polytropa, *Ehrh.* ..	..	*	..	*	..	*
		†47. var. hypopta, *Ach.*	..	..	..	..	..	*
		†112. argopholis, *Whlnb.*	..	..	..	..	*	
		†48. var. thiodes, *Spr.*......	..	..	..	..	..	*
		113. frustulosa, *Dicks.*	..	..	..	..	*	
		†114. atro-sulphurea, *Whlnb.*	..	..	..	..	*	
		†115. epanora, *Ach.*	..	..	..	..	*	
		†116. nephæa, *Smrf.*	..	..	..	..	*	
		117. badia, *Ach.*	*	..	*	..	*	
		†49. var. cinerascens, *Nyl.* ..	..	..	..	..	..	*
		118. atra, *Ach.*	*	..	*	..	*	
		119. ventosa, *Ach.*..............	..	..	..	..	*	
		†120. chlorophana, *Whlnb.*	..	..	..	..	*	
		†121. molybdina, *Whlnb.*	..	..	..	..	*	
		†122. glaucocarpa, *Whlnb.*........	..	..	..	..	*	
		123. fuscata, *Schrad.*	..	..	..	..	*	
		50. var. smaragdula, *Whlnb.*	..	..	..	..	..	*
		†124. peliscypha, *Whlnb.*	..	..	..	..	*	
	30. Urceolaria	125. scruposa, *Ach.*	..	..	..	..	*	
		· 51. var. bryophila, *Ach.* ..	..	..	..	..	..	*
	31. Pertusaria	126. multipuncta, *Turn.*						
		†52. var. leucotera, *Nyl.*....	..	..	..	..	..	*
		127. glomerata, *Ach.*............	..	..	..	..	*	
	32. Varicellaria ...	128. microsticta, *Nyl.*	..	..	..	..	*	
XIV. Lecideei	33. Lecidea	129. foveolaris, *Whlnb.*	*					
		†130. subepulotica, *Nyl.*..........	..	..	*			
		131. pincti, *Ach.*	..	..	..	..	*	
		132. decolorans, *Flk.*	..	..	..	..	*	
		133. atro-rufa, *Ach.*	..	..	..	..	*	
		134. vernalis, *Ach.*	..	..	..	..	*	
		135. turgidula, *Fr.*						
		†53. form pallida, *Nyl.*	..	..	..	..	..	*
		†136. simplicior, *Nyl.*	*					
		137. bacillifera, *Nyl.*						
		†54. var. subfuscula, *Nyl.* ..	..	*				
		138. coarctata, *Ach.*	..	..	*			
		139. pezizoidea, *Ach.*	..	..	..	..	*	
		140. candida, *Ach.*	..	..	..	..	*	
		141. parasema, *Ach.*	*	..	*	..	*	
		55. form rugulosa, *Ach.* ..	..		..	..	..	*
		56. var. enteroleuca, *Ach.* ..	..	*	..	..	..	*
		†57. var. monticola, *Ach.* ..	..	*	..	..	..	*
		†58. var. latypea, *Ach.*	..	*				
		†59. var. incongrua, *Nyl.* ..	..	*				
		142. vitellinaria, *Nyl.*	*					
		†143. alpestris, *Smrf.*............	*					
		†144. stenotera, *Nyl.*	..	..	..	..	*	
		†145. assimilata, *Nyl.*............	..	..	..	..	*	

Tribe.	Genus.	Species and variety.	Iceland. Species.	Iceland. Varieties.	Färö. Species.	Färö. Varieties.	Norway. Species.	Norway. Varieties.
	33. Lecidea	146. contigua, *Fr.*	*	..	*			
		60. form crustulata, *Ach.* ..	..	..	..	..	..	*
		61. var. flavicunda, *Ach.* ..	..	*				
		147. confluens, *Ach.*	*					
		148. lapicida, *Fr.*	*	..	..	..	*	
		†62. var. declinans, *Nyl.*	..	*	..	..	..	*
		†63. subform ecrustacea, *Nyl.*	..	..	..	..	..	*
		†64. var. ochromela, *Ach.* ..	..	*				
		†149. polycarpa, *Flk.*	*	..	..	..	*	
		†150. lithophila, *Ach.*	*	..	..	..	*	
		†65. form ecrustacea, *Nyl.* ..	..	..	..	..	..	*
		†66. form ochracea, *Ach.* ..	..	*				
		†67. var. pallido-cinerea, *Flk.*	..	..	..	..	..	*
		†151. tessellata, *Flk.*	..	..	..	..	*	
		152. amylacea, *Ach.*	..	..	..	..	*	
		†153. areolata, *Schær.*	*					
		†154. aglæa, *Smrf.*	..	..	..	..	*	
		155. fusco-atra, *Ach.*	..	..	..	..	*	
		156. lactea, *Flk.*	*					
		†68. form hypothallina, *Nyl.*	..	..	..	..	..	*
		157. intumescens, *Flk.*	*					
		158. atro-alba, *Flot.*	..	..	*	..	*	
		159. petræa, *Flot.*	*	..	*	..	*	
		†160. excentrica, *Ach.*	*	..	*			
		†161. geminata, *Flot.*	..	..	..	..	*	
		162. albo-atra, *Hffm.*	..	..	..	..	*	
		69. var. epipolia, *Ach.*	..	..	..	..	..	*
		163. disciformis, *Fr.*	..	..	..	..	*	
		†70. var. insignis, *Næg.*	..	..	..	..	..	*
		164. coniops, *Whlnb.*	*	..	*			
		†71. form obscurior, *Nyl.* ..	..	*				
		165. myriocarpa, *DC.*	*	..	..	..	*	
		166. saxatilis, *Schær.*	..	..	..	..	*	
		†167. xanthococca, *Smrf.*						
		†72. form ecrustacea, *Nyl.* ..	..	..	..	..		*
		168. sanguinaria, *Ach.*	..	..	..	..	*	
		169. galbula, *Ram.*	..	..	..	..	*	
		170. alpicola, *Schær.*	..	..	..	..	*	
		171. geographica, *Schær.*	*	..	..	..	*	
		172. citrinella, *Ach.*	..	..	..	..	*	
		†173. Diapensiæ, *Th. Fr.*	..	..	..	..	*	
		†174. Berengeriana, *Mass.*	..	..	..	..	*	
		†175. sarcogynoides, *Körb.*	*					
XV. Graphidei ..	34. Graphis	176. scripta, *Ach.*	..	..	..	..	*	
	35. Arthonia	177. astroidea, *Ach.*	..	..	..	..	*	
		178. varians, *Dav.*	..	..	..	..	*	
XVI. Pyrenocarpei	36. Endocarpon ...	179. miniatum, *Ach.*	..	..	..	..	*	
	37. Verrucaria	180. æthiobola, *Whlnb.*	..	..	*			
		181. maura, *Whlnb.*	..	..	*			
		182. epidermidis, *Ach.*	..					
		73. var. grisea, *Schær.*	..	..	..	..	..	*
	38. Endococcus ..	183. gemmifer, *Tayl.*	*					
		Totals	58	25	21	4	149	63

In 1858 I examined all the lichens in the following public herbaria:—

1. The Hookerian Herbarium, Kew;
2. The Herbarium of the British Museum;
3. The Linnean Herbarium of the Linnean Society; and
4. The Herbarium of the University of Edinburgh, which includes the Menziesian and the Grevillian Herbaria;

as well as several large private herbaria, but with very little fruit as regards lichens from Iceland, Färö, or Norway. Those from Iceland and Färö were under half a dozen; while those from Norway did not exceed three dozen, were mostly contained in the Hookerian Herbarium, and were the fruit of the collection of the indefatigable Sommerfelt (in his 'Itineraria' of 1828). The Kew Herbarium contains sundry specimens labelled as presented or collected by Wahlenberg (1806), and Acharius (1809). No localities, however, are given. The presumption is that they are mostly, if not all, Swedish; but whether or not this be the case, the absence of any note of locality renders it impossible to cite them for present purposes of comparison. Of those lichens of undoubted Norwegian origin which are to be found in the Kew Herbarium, the majority are already enumerated (in my foregoing list). But there are a few not therein included, which I hereto append:—

1. *Trachylia tigillaris*, Pers. On pales, Österdal (*Sommerfelt, Un. Itin.* 1828).
2. *Sphærophoron fragile*, Pers., which I regard as a mere form, always sterile, of *S. coralloides*, Pers. Saxicolous, near Friedrichsvaern.
3. *Stereocaulon coralloides*, Schreb. "Norway," in abundant fruit. Appears to me only a form of *S. paschale*, Laur.
4. *S. denudatum*, Flk. Dovrefjeld (*Smrf. U. I.*).
5. *Alectoria ochroleuca*, Ehrh., var. *sarmentosa*, Ach. Corticolous, on trunks of pines near Christiania (*Smrf. U. I.*). Has much the aspect of an ochroleucous condition of *A. jubata*, L.
6. *A. divergens*, Ach. Summits of the Dovrefjeld (*Smrf. U. I.*), sterile; Lapland (*Wahlenberg*).
7. *Evernia furfuracea*, Mann. Corticolous, woods near Christiania (*Smrf. U. I.*): fruit very large.
8. *Cetraria odontella*, Ach. Saxicolous, Dovrefjeld (*Smrf. U. I.*, fide *Rev. Churchill Babington*).
9. *Platysma triste*, Web. Saxicolous, on alpine rocks, Island of Otterö (*Smrf. U. I.*).

10. *Nephroma arcticum*, L. Alps of Lapland (*Solander, in Herbarium, British Museum*).
11. *Umbilicaria arctica*, Smrf. Saxicolous, on alpine rocks, Island of Otterö, Nordland (*Smrf. U. I.*).
12. *Pannaria triptophylla*, Ach. Corticolous, near Christiania (*Smrf. U. I.*).
13. *Squamaria crassa*, DC. Terricolous, Christiania (*Smrf. U. I.*).
14. *Lecanora varia*, Ach., var. *symmicta*, Ach. Corticolous, on pales, Guldbrandsdal (*Smrf. U. I.*).
15. *L. fuscata*, Schrad., var. *sinopica*, Sm. (E. Bot. t. 1776). Saxicolous, most abundant on ferruginous rocks; on aluminous and ferruginous slate, near Christiania (*Smrf. U. I.*).
16. *Lecidea globifera*, Ach. Kongsvold and other parts of the Dovrefjeld.
17. *L. cuprea*, Smrf. Sneehätten (*Smrf. U. I.*).
18. *L. arctica*, Smrf. On the highest mountains of Nordland (*Smrf. U. I.*).
19. *L. carneo-pallida*, Nyl. Corticolous, Nordland (*Smrf. U. I.*).

Comparing my present list of Icelandic Lichens with that which I published in 1861, and which enumerates all lichens collected in Iceland by various botanists up to that date, the most striking result is, that, as regards the number of species and varieties, the former is fully as large as the latter; in other words, my week's collection around Reykjavik equals the collections of all previous botanists in all other parts of the island. Such a result merely indicates the great imperfection of our present knowledge of the Lichen-flora of Iceland. My own collection amounts to 83 species (including well-marked varieties and forms); the list given in my 'Flora' of 1861 enumerates 82. The latter includes 52 lichens which were not found by myself, and which fall to be added to my list of 83. This gives 135 as a total of the Lichen-flora of Iceland, so far as it is at present known with any degree of exactitude. This, however, is probably far short of the real total, many species, varieties, and forms remaining to be added by the research of future travellers *.

* I have since found the following species and varieties (which are not included in the above-mentioned enumerations of Icelandic Lichens) recorded in Fries's Lich. Arctoi [*vide* foot-note §, p. 366]:—

1. *Leptogium muscicolum*, Sw., Vahl.
2. *Neuropogon melaxanthus*, Ach. [*Lichen sulphureus*, Fl. Isl.], Vahl.
3. *Alectoria jubata*, L., var. *chalybeiformis*, L., Steenstrup.
4. *A. ochroleuca*, Ehrh., var. *cincinnata*, Fr., Steenstrup.

The following are the lichens not found by myself, but recorded in my 'Flora' as having been collected by the numerous botanical travellers who have during the last century visited Iceland:—

1. *Collema nigrescens*, Ach.
2. *Sphærophoron fragile*, Pers.
3. *Stereocaulon tomentosum*, Laur., and var. *incrustatum*, Flk.
4. *Thamnolia vermicularis*, L. (Vahl).
5. *Usnea barbata*, Fr., var. *hirta*, L.
6. *Alectoria jubata*, L.
7. *A. ochroleuca*, Ehrh., and var. *sarmentosa*, Ach.
8. *Evernia furfuracea*, Mann.
9. *E. prunastri*, L.
10. *Ramalina calicaris*, Ach., and vars. *fraxinea*, L., and *farinacea*, L.
11. *Platysma Fahlunense*, L.
12. *Nephromium tomentosum*, Hffm.
13. *Peltigera aphthosa*, Hffm. [Steenstrup].
14. *P. venosa*, Hffm.
15. *P. rufescens*, Hffm.
16. *Solorina saccata*, L. [Steenstrup].
17. *S. crocea*, L.
18. *Sticta pulmonacea*, Ach.
19. *S. scrobiculata*, Scop.
20. *Parmelia physodes*, L.
21. *P. olivacea*, L.
22. *P. stygia*, L.
23. *Physcia candelaria*, Ach.
24. *P. ciliaris*, L.
25. *Umbilicaria pustulata*, Hffm.

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5. *Ramalina polymorpha*, Ach., Vahl.
6. *Umbilicaria arctica*, Ach., Mörck.
7. *Parmelia encausta*, Sw., Steenstrup.

The *P. arctica* mentioned, on Dr. Nylander's authority, at p. 379 does not occur in Th. Fries's L. Arct. Probably the lichen referred to really belongs either to *P. encausta* or *P. alpicola*. Th. Fr. L. Arct. 57.

8. *Physcia obscura*, Ehrh., Steenstrup.
9. *Pannaria prætermissa*, Nyl. Scand. 124 & 290 [*P. lepidiota*, Th. Fr. L. Arct. 74].
10. *Lecidea decipiens*, Ehrh., Steenstrup.
11. *L. fusco-lutea*, Dicks. [*Caloplaca*, Th. Fr. L. Arct. 121], Vahl.
12. *Urceolaria scruposa*, Ach.

This number added to 135 gives 147 as the present total recorded Lichen-flora of Iceland.

26. *U. polyphylla*, L. [Steenstrup], and var. *deusta*, Ach.
27. *U. vellea*, Ach.
28. *U. hirsuta*, Ach.
29. *Pannaria triptophylla*, Ach.
30. *Placodium murorum*, Hffm., and vars. *obliteratum*, Pers. (*Lecanora lobulata*, Smrf.), and *miniatum*, Hffm.
31. *Psoroma hypnorum*, Hffm.
32. *Urceolaria scruposa*, Ach.
33. *Lecanora calcarea*, Ach.
34. *L. tartarea*, Ach.
35. *L. ventosa*, Ach.
36. *L. sulphurea*, Ach.
37. *L. verrucosa*, Laur. [Steenstrup].
38. *Lecidea fusco-atra*, Ach.
39. *L. decolorans*, Flk.
40. *L. atro-alba*, Flot.
41. *L. sanguinaria*, Ach.
42. *L. arctica*, Smrf.
43. *Endocarpon miniatum*, Ach.
44. *E. hepaticum*, Ach.
45. *Verrucaria tephroides*, Ach.*

Though not found by myself in *Iceland*, about 45 per cent. of the foregoing lichens occur in my *Norwegian* collection. Of the total of 83 species and varieties collected by myself, 53 (or 63 per cent.) are not mentioned in my 'Flora,' and are presumably, therefore, new to the Lichen-flora of Iceland, though they are for the most part more or less common in Scandinavia and Northern Europe generally.

The only lists of Färöese lichens with which I am acquainted are those of Landt† and Sir Walter Trevelyan‡. The whole of the lichens enumerated by Landt amount only to 24; some of these are merely varieties of other species; all are classed under the old and comprehensive genus *Lichen*. The following were not found by myself, though they occur in Landt's catalogue:—

1. *Nostoc commune*, Vauch. (*Tremella Nostoc*, E. Bot. t. 461).
2. *Sphærophoron coralloides*, Pers.

* 45 species (including cases where the type is represented only by a variety).
 7 varieties and forms in addition to the type.
 —
 52 total.

† 'A Description of the Färö Islands,' 1810, p. 194.

‡ "On the Vegetation and Temperature of the Färö Islands," Edinb. New Philosoph. Journ. vol. xviii. [1835] p. 154.

3 *fragile*, Pers.
Stereocaulon paschale, Laur

5. *Alectoria jubata*, L., var. *chalybeiformis*, L.
6. *Evernia furfuracea*, Mann.
7. *Ramalina calicaris*, Ach., and var. *farinacea*, L. Both saxicolous*.
8. *Peltigera aphthosa*, Hffm.
9. *P. canina*, Hffm. Old corn-fields. "Yarasipa" of the Färöese.
10. *Umbilicaria proboscidea*, DC. Abundant on the road between Leynum and Kollefjord, Stromö. This is an interesting example of a subalpine lichen occurring at a low elevation in an insular position.
11. *Squamaria gelida*, L. (*Lichen Heclæ*, Gunn.). "High up on the hills, on small loose stones."
12. *Parmelia saxatilis*, Ach., var. *omphalodes*, L.
13. *P. physodes*, L.
14. *P. encausta*, Sm.
15. *P. olivacea*, L.
16. *Physcia ciliaris*, L.
17. *P. stellaris*, L.
18. *Lecanora calcarea*, Ach. A variety, I think, of the common *L. cinerea*, L.
19. *Lecidea geographica*, L.

Sir Walter Trevelyan's list, again, contains a further number of seventeen species which occur neither in my collection nor in Landt's enumeration, viz. :—

1. *Collema flaccidum*, Ach.
2. *C. spongiosum* (probably *Lichen spongiosus*, Sm. Eng. Bot. t. 1374, which is a variety of *Solorina saccata*, L., Nyl. Scand. 92).
3. *Leptogium lacerum*, Sw.
4. *Thamnolia vermicularis*, L. The occurrence of this Alpine lichen at a comparatively low level and in an insular position is noteworthy.
5. *Usnea barbata*, Fr., var. *hirta*, L.
6. *Ramalina calicaris*, Ach., var. *fastigiata*, Pers.
7. *Peltigera polydactyla*, Hffm.
8. *P. venosa*, Hffm.

* The forms here mentioned are much more probably *R. scopulorum* or *R. polymorpha*; but it is obviously impossible to determine such a point without access to the authenticated lichens referred to by Landt.

9. *Solorina crocea*, L.
10. *Parmelia lanata*, L.
11. *Physcia aquila*, Ach.
12. *Umbilicaria cylindrica*, L.
13. *Pannaria muscorum*, Ach.
14. *Lecidea fusco-lutea*, Dicks.
15. *L. confluens*, Ach., pr. p.
16. *L. viridescens*, Ach.
17. *Endocarpon miniatum*, Ach.

It has to be remarked, in regard to the lists quoted from Landt and Sir W. C. Trevelyan, that inasmuch as the names assigned by these authors depended on external or naked-eye characters alone, without microscopical examination and reference to the nature of the spores, it is impossible to guarantee the accuracy of the modern synonymy offered. This has been already illustrated in the case of what was called by the earlier lichenologists *Collema spongiosum*; and it may be further illustrated by such names as *Pannaria muscorum*, *Lecidea confluens*, *L. viridescens*, and *L. fusco-lutea* in Sir W. C. Trevelyan's list, which may have been really different (though allied) lichens, and each of which may have included more than one species. In the absence of microscopical examination it is impossible to distinguish from each other many of the lower or crustaceous lichens, which have very similar external characters; from which it follows that lists drawn up without reference to the characters of the spores at least, are certain to omit many species that would otherwise be included; in other words, they are inadequate or imperfect representatives of the special Lichen-flora they are designed to illustrate.

The lichens I collected about Thorshavn amount to	26
The additional number contained in Landt's list is	21
And in Sir Walter Trevelyan's	17
Giving a total of..............................	64

There can be no doubt, however, that this total by no means represents adequately the Lichen-flora of Färö. The lists of Landt and Trevelyan are disproportionately small as regards the very lichens which are sure to predominate in such a country—that is, crustaceous, minute and obscure species, liable to be overlooked, and requiring careful microscopical examination for their discrimination and determination. As in the parallel case of Iceland, I have no hesitation in affirming that large additions remain to be made to the Färöese Lichen-flora, especially in the direction

just indicated; and I may go further and venture to predict that when we possess a full and accurate knowledge, on the one hand, of the Lichens of Iceland and Färö, and, on the other, of those of Shetland, Orkney, and the Hebrides, there will be found to be a close resemblance or alliance between them.

Of my Thorshavn collection there are twenty lichens not mentioned by Landt, and fifteen not enumerated by Trevelyan.

As was to be expected, there is a close correspondence or resemblance between the Lichen-floras of Iceland, Färö, and Norway on the one hand, and of Britain on the other. It would undoubtedly be much closer, however, between that of Scotland—with its outlying islands the Hebrides, Orkney, and Shetland—and of these more northern islands or countries, had we the proper means of forming a comparison. But no separate, recent, full and accurate list of the lichens either of Scotland, Norway, Iceland, or Färö has yet been published. Of the whole list of my collections in Iceland, Färö, and Norway, upwards of two-thirds are British. The British Lichen-flora is considerably poorer than that of the Scandinavian peninsula, if we can depend on comparisons based on data furnished by works so different as Mudd's 'Manual' (1861), as representing Britain, and Nylander's 'Lichenes Scandinaviæ' (1861), as representing Sweden and Norway*.

But in order to an accurate comparison, the lists of Scandinavian and British lichens would require to be drawn up by the same author; for no two lichenologists take the same views of species and varieties, some regarding as species what others consider only varieties or forms. Hence in the hands of two different authors the same lichens will be very differently stated numerically; from which it follows that we cannot safely contrast statistical data of such a character drawn from one work with those of another.

Proportionally or comparatively the British should be richer

* But in neither work, and more especially in Nylander's, are the species and the dominant varieties distinguished or catalogued in such a way as to render it possible for a reader to number them accurately. While Nylander himself (Scand. p. 7) states the whole Scandinavian lichens at only 446 species, I find the number separately catalogued apparently as species in his 'Lichenes Scandinaviæ' to be upwards of 570, or about 130 more than his own enumeration, which is presumably the more correct; the varieties or forms he enumerates, moreover, amount to upwards of 360,—which gives a total of 930. A similar calculation from Mudd's 'Manual' gives about 500 species and upwards of 280 varieties or forms, or a total of 780,—that is, less than the Scandinavian list by 150. But I repeat I do not consider these statistics at all to be relied upon.

than the Scandinavian Lichen-flora. The reasons or causes of this anticipated superior richness are to be found in the more southern latitude of Britain, in the greater variety of its geological constitution and physical configuration, as well as of its arboreal vegetation. Contrasting, however, Scotland alone and Norway, I am not sure that the balance would be in favour of the former. My general impression, from alpine excursions especially in both countries, and in the absence of precise data for determination, is that the alpine Lichen-flora of Norway is richer than that of Scotland. It is unprofitable, however, to discuss such a question until the possession of accurate lists of the lichens both of Scotland and Norway enables us to do so with some precision*.

Meanwhile the affinities between the alpine and subalpine Lichen-floras of Scotland and Norway are most interesting. The researches of Scottish lichenologists during the last fifteen years have brought to light a considerable number of more or less rare and interesting species which are common to the alps of Scotland and Norway; and this number is constantly being added to. The experience of the past twenty years warrants us in saying that while certain Norwegian alpine lichens remain yet to be discovered in the highlands and islands of Scotland, there are also certain Scotch alpine forms which are yet probably to be found on the Norwegian alps, as Nylander† points out in regard, *e. g.*, to *Verrucaria scotinospora*, Nyl., and *V. verrucoso-areolata*, Schær. Neither country can yet be said to be thoroughly explored in regard to the lichens of the less known and more remote districts.

As of much interest to the lichenologists of both countries, I venture to append a list of the principal lichens which are common to the alpine districts of Scotland and Norway, all of which,

* The 'Edinburgh Cabinet Library,' volume on "Iceland, Greenland, and Färö" (1840, p. 877), gives the following comparative numerical statement of the Lichen-flora of

	No. of species.
Scotland	260
Färö	50
Iceland	60
Greenland	59

—from which it would appear that the Scottish stand to Icelandic lichens in the proportion of more than 4 to 1, and to the Färöese of more than 5 to 1. Such statistics, however, are comparatively valueless, because the data on which they are founded (the names of the lichens described by botanists prior to the application of the microscope to the study of their spores) cannot be relied on.

† Lich. Scand. p. 270.

however, I do not profess myself to have found either on the Scottish or Norwegian mountains :—

* indicates the more alpine forms.

1. *Leptogium tremelloides*, Ach.
2. *Calicium trichiale*, Ach.
3. *Coniocybe furfuracea*, Ach.
4. *Bæomyces placophyllus*, Ach.
5. *Stereocaulon paschale*, Laur., and form *coralloides*, Nyl.
*6. *S. tomentosum*, Laur., and *vars. *alpinum*, Laur., and **botryosum*, Laur.
7. *S. denudatum*, Flk.
8. *S. condensatum*, Hffm., and var. *cereolinum*, Ach.
9. *S. nanum*, Ach.
*10. *Thamnolia vermicularis*, L.
*11. *Alectoria ochroleuca*, Ehrh., and *var. *sarmentosa*, Ach.
*12. *A. bicolor*, Ehrh.
13. *Cetraria Islandica*, L., and var. *crispa*, Ach.
*14. *Platysma nivale*, L.
*15. *P. cucullatum*, Hffm.
*16. *P. Fahlunense*, L.
17. *P. juniperinum*, L.
18. *P. sæpineolum*, Hffm.
*19. *P. triste*, Web.
20. *Nephromium lævigatum*, Ach.
21. *Peltigera horizontalis*, Hffm.
22. *P. venosa*, Hffm.
*23. *Solorina crocea*, L.
24. *S. saccata*, L.
25. *Stictina scrobiculata*, Scop.
26. *S. fuliginosa*, Dicks.
27. *S. sylvatica*, L.
28. *S. limbata*, Sm.
29. *Ricasolia herbacea*, Huds.
30. *R. glomulifera*, Lightf.
31. *Parmeliopsis ambigua*, Wulf.
32. *P. aleurites*, Ach.
33. *P. placorodia*, Ach.
34. *Parmelia pertusa*, Schrank.
*35. *P. encausta*, Ach., and *var. *candefacta*, Ach.
*36. *P. stygia*, L.
*37. *P. lanata*, L.
38. *P. conspersa*, Ach.

39. *P. Mougeottii*, Schær.
40. *Physcia speciosa*, Hffm.
41. *Umbilicaria cylindrica*, L.
42. *U. proboscidea*, DC.
*43. *U. erosa*, Hffm.
*44. *U. hyperborea*, Hffm., and *var. *arctica*, Ach
45. *U. polyphylla*, L.
46. *U. polyrrhiza*, L.
47. *Pannaria rubiginosa*, Thunb.
*48. *P. leucolepis*, Ach.
49. *Coccocarpia plumbea*, Lightf.
50. *Squamaria gelida*, L.
51. *Placodium elegans*, DC.
52. *Lecanora cerina*, Ehrh., and var. *stillicidiorum*, Œd.
53. *L. albella*, Pers.
*54. *L. tartarea*, Ach., and var. *frigida*, Sm.
*55. *L. oculata*, Dicks.
*56. *L. verrucosa*, Laur.
*57. *L. pelobotrya*, Whlnb.
58. *L. fuscata*, Schrad., and vars. *sinopica*, Sm., and *smaragdula*, Whlnb.
*59. *L. frustulosa*, Dicks. and Sm. E. Bot.
60. *L. sophodes*, Ach., var. *confragosa*, Ach.
61. *Pertusaria leioplaca*, Ach.
*62. *P. glomerata*, Ach.
*63. *P. bryontha*, Ach.
64. *Lecidea lurida*, Ach.
65. *L. globifera*, Ach.
*66. *L. decipiens*, Ach.
67. *L. candida*, Ach.
68. *L. citrinella*, Ach.
*69. *L. galbula*, Ram.
70. *L. scabrosa*, Ach.
*71. *L. armeniaca*, DC.
*72. *L. pezizoidea*, Ach.
73. *L. Dilleniana*, Ach.
74. *L. albo-atra*, Hffm., and var. *ambigua*, Ach.
75. *L. sabuletorum*, Flk., and var. *montana*, Nyl.
*76. *L. arctica*, Smrf.
77. *L. lugubris*, Smrf.
78. *L. tenebrosa*, Flot.
*79. *L. coracina*, Ach.

80. *L. badio-atra*, Flk.
81. *L. Œderii*, Ach.
*82. *L. parasema*, Ach., var. *latypea*, Ach. (*L. coniops*, Ach. pr. p.).
83. *L. oxyspora*, Tul.
84. *Normandina lætevirens*, Turn. & Borr.
85. *Endocarpon rufescens*, Ach.
86. *E. miniatum*, Ach., and var. *euplocum*, Ach.
87. *Verrucaria tephroides*, Ach.
88. *V. pyrenophora*, Ach.
89. *V. margacea*, Whlnb., and var. *hydrela*, Ach.
90. *V. umbrina*, Whlnb.

Contrasting Iceland, Färö, and Norway with each other and with Scotland, there are certain striking diversities as regards their geological formation and physical configuration, as well as the presence or absence of arboreal vegetation, which demand attention as bearing materially on the character of their respective Lichen-floras.

Iceland is composed of comparatively recent volcanic rocks, overlain or not by a sterile scanty soil, the result of their disintegration. In this respect it cannot fairly be compared with any nearer southern country than the volcanic districts of France, Italy, and Sicily. Reykjavik is seated in the midst of what is virtually a stony desert, the soil being made up of fragments of all sizes of dolerite, trachyte, and lava. The metropolitan district, indeed, is stated by the natives to be the most barren in the island. Looked at from any distance it has a brown or blackish-brown colour, and a bleak sterile aspect*. There is too little greensward or phænogamous vegetation to become a feature in the landscape. This is the character of a great portion at least of the island,—the bare lava, or the brown stony soil resulting from its partial disintegration, being generally less or more devoid of the higher vegetation. There are occasional or exceptional oases in this brown desert, *e. g.* around farm-houses, the banks of rivers, streams, and lakes, in marsh-lands, and in the vicinity of hot and other springs. But these exceptions scarcely affect the Lichen-flora of the country. There is, however, a considerable variety of configuration in the country; and the mountains, many of which are covered with perennial snows feeding large glaciers, reach a height of nearly 6000 feet. There are, however, no forests, and almost no arboreal

* 'Flora of Iceland,' p. 24.

or fruticose vegetation*. Undoubtedly this is one of the main causes of the paucity of the lichens of Iceland. It would be natural to suppose that the rugged, hard, recent lava would be one of the last supports of a lichenose, or higher, vegetation. But that such is not altogether or necessarily the case was long ago noticed by Sir Charles Lyell in regard to Etna, Vesuvius, and the Canary Islands alike; and similar observations have been made by other travellers in other volcanic countries. Sir Charles describes Lichens as the first characteristic vegetation of modern lavas, especially species of *Stereocaulon,* which are sometimes so plentiful as to *whiten the lava*; and he remarks, "The natural growth, even of a cryptogamous vegetation, although restricted to limited areas, on lava of such recent date is worthy of notice, and seems to give promise of an early fertility for the future"†. I have already referred to the apparent parallelism which exists between the deserts of Iceland and the "Tundras" of Lapland, especially what Baer describes as the "Flechtentundra" (whereon lichens are the dominant forms of vegetation), which is brown, dry, and arid, as compared with the "Moostundra" (whereon mosses predominate over other forms of vegetable life), which is comparatively moist and green. On these North-Russian deserts Fellman also refers to the paucity of Lichen-*species* though not of *individuals*—a paucity which he attributes, apparently with justice, to the absence of forests. The lichen-vegetation of these treeless wastes, as described by Fellman‡—and which consists of species of *Cladonia, Stereocaulon, Platysma,* and *Cetraria,* covering whole tracts of country—resembles that (of many parts at least) of Iceland.

The Färö Islands are trappean, and are comparable—*quoad* their geological constitution and physical configuration—with certain of the Scottish Islands, such as Mull and Skye, and certain districts of the Scottish mainland, such as Arthur's Seat and the Braid Hills near Edinburgh, or the Sidlaw and Ochil Hills near Perth§. Their Lichen-flora is more allied to that of Iceland than of Norway. When we possess a full list of the lichens of the Färö group, on the one hand, and the Shetland Islands, on the other, there will

* The exceptions consist mainly of patches of stunted birch bushes in some parts of the country.

† Memoir on "The Lavas of Mount Etna," Philosoph. Transact. part 2 for 1858, p. 726.

‡ "Voyage botanique dans la Laponie orientale," by M. N. I. Fellman, Bull. de la Soc. Botan. de France, Nov. 27, 1863.

§ The greatest elevation in Färö is the hill called Slattaretind, which is about 2900 feet high.

probably be found to exist a close general resemblance of their respective Lichen-floras.

Norway consists mainly of metamorphic slates, generally largely micaceous, associated with granites. In respect of its geological structure and superficial configuration it resembles the Grampian and trans-Grampian region of Scotland. Its mountains exceed in height those of Iceland by upwards of 2000 feet,—Skagstolstind, the greatest elevation not only in Norway but in Scandinavia, being 8670 feet; while Oræfa, the highest of the Icelandic Alps, is 5927. The Norwegian, like the Icelandic, Alps are capped with perennial snows, which feed magnificent glaciers. In the month of August (1857) I found Sneehätten and the Haalangenfjeld capped with snow; and they are said to be always more or less so. In the month of June (1860) there was a copious covering of snow on Snæfell, and a scanty mantle on Eyafjalla in Iceland. But at the same time there was a slight covering on our own Grampians, hills of only 1000 to 1800 feet, and about 8 degrees further south; while Snæfell is 4600 and Eyafjalla 5685 feet*. Norway lies considerably to the south of Iceland, though the Dovrefjeld region is nearly in the same latitude as the Färös. But the main cause of the much greater richness of its Lichen-flora is to be found in the abundance of its forests and the variety of its arboreal vegetation. Not only the lowland and alpine valleys, but frequently the Alps themselves (up to at least 3000 feet) are covered by dense forests. On the flanks of the Alps these consist mostly of such trees as Scotch fir, spruce, larch, and birch. In the alpine valleys, the lesser rowan, alder, juniper, willow, and dwarf birch abound†. And in lowland districts, such as the vicinity of Christiania, the *Coniferæ*, *Betulaceæ*, and *Salicaceæ* are replaced by the ash, sycamore, and other more southern trees. The forest-trees, especially in the valleys of the interior, support large quantities of species of such Lichen-genera as *Usnea*, *Ramalina*, *Alectoria*, *Platysma*, *Parmelia*, *Physcia*, *Lecanora*, and *Lecidea*; while certain *Graphideæ* or other groups or genera also occur which are apparently unknown in Iceland and Färö. In the fir-

* *Vide*, in regard to the physical geography of Iceland, the paper, on the "Eruption of Kötlugjá," already quoted (*vide* p. 368). Where not otherwise specified, heights of Icelandic mountains are those given in English feet by Keith Johnston in his 'Physical Atlas,' 1848.

† About Jerkin, juniper, dwarf birch (*Betula nana*, L.), and willows occur. The Scotch fir and birch climb nearly to the plateau of the Dovrefjeld (3000 feet); and the alpine valleys of the same mountain-range abound in alder.

woods of Norway I found, speaking generally, the same lichens as in those of Scotland; and on the same species of tree I usually found the same species of lichen in the two countries. The cracked bark of old birch trees was generally infested with forms of *Usnea barbata*, *Parmelia saxatilis* and *olivacea*, *Physcia parietina*, *pulverulenta*, and *stellaris*, and *Verrucaria epidermidis*. On the ash (about Christiania) occurred chiefly *Parmelia tiliacea* and *olivacea*, *Platysma glaucum*, *Physcia parietina*, *pulverulenta*, and *stellaris*, *Lecanora subfusca* and *aurantiaca*, and *Lecidea parasema*. On the sycamore (also in the lowlands) the same lichens were met with as on the ash. On the alder, which is very common, and grows to considerable size on the sand and mud banks or hillocks of Eidsvold, on the Mjösen Lake, were seen *Graphis scripta*, and *Lecidea parasema* and *disciformis*.

Scotland, however, in addition to a more southerly latitude, has a more varied geological basis than Iceland, Färö, and Norway put together; its arboreal vegetation is also much more diversified, while it is perhaps as abundant as that of Norway. It may therefore possess a more varied and richer Lichen-flora than these three more northern countries put together*. But at present, as already shown, there are not materials for determining this.

My list of Icelandic, Färöese, and Norwegian lichens is much too meagre and from too limited areas to enable me to deduce, or warrant me in deducing general conclusions regarding the characteristics of the Lichen-flora of, or the distribution of species in, those portions of Northern Europe. My data are sufficient, however, to indicate meanwhile the following facts of interest, viz. the comparative abundance of certain families or genera, and the comparative paucity or the absence of certain others. Especially abundant are the groups—

	No. of species.
1. *Lecideæ*, terricolous, muscicolous, and saxicolous	67
2. *Lecanoræ*, terricolous, muscicolous, and saxicolous ..	57
3. *Umbilicariæ*, especially in Norway	14
4. *Platysmata*, especially terricolous, muscicolous, and corticolous	9
Total lichens collected	256

* The only doubt that can exist, indeed, is in regard to the lichens of Scotland as compared with those of Norway (as already stated, page 399).

As markedly deficient are the—

Tribes.	Genera.	No. of species.
I. *Graphidei*	1. *Graphis*	1
	2. *Arthonia*	2
II. *Collemacei*	3. *Collema*	1
III. *Pyrenocarpei*	4. *Endocarpon*	1
	5. *Verrucaria*	4
IV. *Parmelei*	6. *Stictina*	1
	7. *Sticta*	1

There are also certain peculiarities of geographical or topographical distribution which are worthy of note.

In Iceland I found *Platysma nivale* overspreading in large masses the deserts to the south-east of the Cemetery at Reykjavik, growing frequently where no phænogams and no other cryptogams could vegetate, usually associated with tufts or masses of *Cetraria aculeata*. Both lichens were sterile and dwarfish, however. *Cetraria Islandica* and *Cladonia rangiferina*, which one would *à priori* have expected to luxuriate in such a locality, occurred sparingly, the former especially usually intermixed with *Rhacomitrium lanuginosum*, Bridel—a moss so abundant in Iceland that it occupies very much the place of *Cladonia rangiferina* in other countries*. The *Umbilicariæ* are rare about Reykjavik (Reykjavik Observatory 56 feet Danish above sea-level) †. I found the apothecia of almost all the crustaceous lichens collected more or less deformed; and this peculiarity may be common in Iceland, as it is generally in alpine countries.

At Christiansand, in the extreme south of Norway, about parallel of latitude 58° (which passes through the south of Sutherlandshire), and on granite, at the sea-level, the *Umbilicariæ* (*U. pustulata* and *spodochroa*) grow in profusion and to a great size. On the other hand, on the Dovrefjeld and Haalangenfjeld, where rather they would have been expected to luxuriate, I found them very small in size, and very few both as regards species and individuals ‡. In other words, they appeared to reach their maximum development in the extreme south and at the sea-level, decreasing

* The same moss, with its ally *R. canescens*, Hedw., often attaining a length of 1 foot, covers the Färöese hills, according to Sir Walter Trevelyan.

† A Danish foot is equal to 12⅜ English inches; so that it is a fraction larger; but the difference is so slight that it may for such purposes as the present be practically disregarded.

‡ About Jerkin they are not common; and on the Haalangenfjeld I found them small and disappearing.

in size and number as we proceed northward and ascend the Alps. In this country we are in the habit of regarding the *Umbilicariæ* as alpine lichens, which are to be looked for the more highly developed and more extensively diffused the higher we ascend. I have, however, in Scotland met with several species at or near the sea-level—for instance, in Skye and on various Perthshire and other moors, which localities cannot be considered in any sense even subalpine or montane. Similar remarks apply to the variety *omphalodes* of *Parmelia saxatilis*. *Lecidea geographica* occurs on boulders at the sea-level around Christiansand. I have met with it at very low levels also in Scotland, but generally on boulders (originally from the Highland mountains) of gneiss, mica-slate or quartzite. On such boulders (erratic blocks from the Grampians) in the lowlands of Perth, within 300 to 500 feet of the sea-level, I have found other lichens which are generally found only in our Highlands. But a still more striking instance of the connexion between lichens and the lithological character of their basis of growth or support is to be found in the huge erratics of the great North German plain, originally Scandinavian, which support subalpine lichens totally alien to the general character of the Lichen-flora of the Baltic countries. *Placodium elegans*, another of these cosmopolite lichens, more or less common almost everywhere, I found from the coast up to Sneehätten. In some of the forests of the interior clothing the hills and valleys, and consisting mostly of Scotch fir and birch, there were sometimes few of the higher corticolous lichens: frequently no *Usneæ* or *Ramalinæ*.

The parts of Iceland and Norway which I visited were south of the arctic circle; so that geographically no part of my collections is entitled to the appellation *arctic* or *subarctic*. In a list, however, which includes so many *alpine* species and not a few *cosmopolites*, we should expect a considerable proportion at least to occur also in arctic regions. Contrasting my list with that given by my friend the Rev. W. A. Leighton, in the Society's Journal, of the Lichens collected by Sir John Richardson*, it appears that about 60, *i.e.* 23·43 per cent., or nearly one-fourth of my Icelandic, Färöese and Norwegian lichens occur also in Arctic America. This, however, is regarding *arctic* America as beginning not at the arctic circle but at parallel of lat. 60°, which

* "Notes on Lichens collected by Sir John Richardson in Arctic America," Journal of the Linnean Society, (Botany) vol. ix. p. 184.

in Europe passes through Southern Norway, and includes most of the localities of my collections*. While Sir John Richardson's collections include genuine alpines such as:—

1. *Thamnolia vermicularis*, L.
2. *Alectoria ochroleuca*, Ehrh.
3. *Platysma cucullatum*, Hffm.
4. *Parmelia stygia*, Ach.
5. *P. lanata*, L.
6. *Umbilicaria erosa*, Hffm.
7. *U. vellea*, Ach.
8. *Lecanora oreina*, Ach.
9. *L. verrucosa*, Laur.
10. *L. fulvo-lutea*, Nyl.

it also includes such common lowland forms, albeit they are cosmopolites, or very widely distributed over the globe, as:—

11. *Usnea barbata*, Fr., and its vars. *hirta*, L., *plicata*, L., and *ceratina*, Ach.
12. *Evernia prunastri*, Ach.
13. *Ramalina calicaris*, Fr., and var. *farinacea*, L.
14. *Peltigera canina*, Hffm.
15. *Parmelia saxatilis*, Ach.
16. *P. olivacea*, Ach.
17. *Physcia pulverulenta*, Fr.
18. *P. cæsia*, Hffm.
19. *P. obscura*, Fr.
20. *Squamaria saxicola*, Pollich.
21. *Placodium elegans*, DC.
22. *Lecanora vitellina*, Ach.
23. *L. glaucoma*, Ach.
24. *Lecidea geographica*, Sch.
25. *L. disciformis*, Fr.
26. *Verrucaria epidermidis*, Ach.

If we substitute the more arctic collections of Dr. Walker, from latitude 72° in Greenland and America†, for those of Sir John Richardson, the number of lichens which also occur in my Ice-

* The presence of trees and shrubs in the regions visited by Sir John gives them a great advantage over treeless countries, like Iceland and Färo, as regards the comparative richness of their lichenose vegetation.

† "An Account of the Plants collected by Dr. Walker in Greenland and Arctic America during the Expedition of Sir Francis MClintock, R.N., in the yacht 'Fox,'" by Dr. Hooker—Journal of the Linnean Society, (Botany) vol. v. p. 87 (Lichens determined by Mr. Mitten).

landic, Färöese, and Norwegian collection is thirty-one, or about 12·1 per cent. This arctic collection, while it contains only one strictly arctic lichen (*Dactylina arctica*, Hook.), with a few alpine or subalpine ones (such as *Dufourea madreporiformis*, Ach., *Alectoria ochroleuca*, Ehrh., *Solorina crocea*, L., and *saccata*, L., *Platysma nivale*, L., and *juniperinum*, L., *Parmelia stygia*, Ach., and *lanata*, L., *Umbilicaria hyperborea*, Hffm., and *hirsuta*, Ach., *Lecanora chlorophana*, Whlnb., and *frustulosa*, Dicks., and *Lecidea alpicola*, Sch.), contains also such common and almost ubiquitous forms as *Cladonia pyxidata*, L., *deformis*, L., *gracilis*, Hffm., *rangiferina*, Hffm., and *bellidiflora*, Ach., *Sphærophoron coralloides*, Pers., *Alectoria jubata*, Ach., *Parmelia saxatilis*, Ach., and *conspersa*, Ach., *Physcia pulverulenta*, Fr., and *candelaria*, Ach., *Placodium murorum*, Hffm., and *elegans*, DC., *Lecanora subfusca*, Ach., and *vitellina*, Ach., *Urceolaria scruposa*, Ach., *Lecidea geographica*, Sch., and *lapicida*, Fr.

Many of the lichens contained in my list, which are, in Europe, among the most characteristic alpine and northern forms, curiously enough do not appear at all in lists of arctic lichens. For instance, none of the following are to be found in the collections either of Sir John Richardson or Dr. Walker:—

1. *Pyrenopsis hæmatopis*, Smrf.
2. *Bæomyces placophyllus*, Ach.
3. *Siphula ceratites*, Fr.
4. *Parmelia arctica*, Th. Fr.
5. *P. centrifuga*, Ach.
6. *Umbilicaria stipitata*, Nyl.
7. *U. atro-pruinosa*, Sch.
8. *U. spodochroa*, Hffm.
9. *U. flocculosa*, Hffm.
10. *Pannaria leucolepis*, Whlnb.
11. *Placodium bracteatum*, Hffm.
12. *Squamaria straminea*, Ach.
13. *Lecanora sinapisperma*, DC.
14. *L. nimbosa*, Fr.
15. *L. pelobotrya*, Smrf.
16. *L. poliophæa*, Whlnb.
17. *L. argopholis*, Whlnb.
18. *L. atro-sulphurea*, Whlnb.
19. *L. epanora*, Ach.
20. *L. nephæa*, Smrf.
21. *L. molybdina*, Whlnb.

22. *Pertusaria glomerata*, Ach.
23. *Varicellaria microstictica*, Nyl.
24. *Lecidea Diapensiæ*, Th. Fr.
25. *L. alpestris*, Smrf.
26. *L. stenotera*, Nyl.
27. *L. assimilata*, Nyl.
28. *L. aglæa*, Smrf.
29. *L. areolata*, Schær.
30. *L. xanthococca*, Smrf.

While the development of our commerce, the multiplication and improvement of our manufactures, the facilitation of means of travel and transport consequent on the applications of steam, and the superior wealth and education of our people have combined almost entirely to put an end, in this country, to the use of lichens as food, in medicine, or the domestic arts, Lichens continue to be, in northern and arctic regions of both the old and new world, of immense importance, not only as fodder to animals on which man in great measure subsists, but as food, under exceptional (and sometimes, alas! normal) conditions, to man himself. Not only did I meet with evidence of their economical applications at the present day, in the course of my own excursions, but I have recorded in my note-books numerous instances and proofs cited from the most recent works of northern travel. A few of these notanda I append as furnishing interesting illustrations of the economical applications of lichens as food, in medicine, or the arts, at the present day.

Economically regarded, perhaps the most important of all the northern lichens is *Cladonia rangiferina*, Hffm., the so-called "Reindeer Moss." It frequently overspreads large tracts of sterile country in northern and arctic Europe and America, constituting sometimes the sole terrestrial vegetation. As such it is the main support in Lapland and Esquimo-land* of the reindeer, one of the chief articles of food of the inhabitants. In some parts of Norway this lichen is also regularly used as a winter fodder for cattle. About the end of September it is scraped into heaps by means of large iron rakes, and the position of these heaps is marked by poles sufficiently tall to be visible above the winter snows. In the same country it is commonly used as a stuffing-material in the construction of the usual log houses: it is inserted between the logs or beams forming the walls, intermixed or not with *Sphagna* or similar

* Recent Voyages of Hall, 1864.

mosses. Near forests various corticolous lichens are similarly employed, e. g. *Alectoria jubata, Evernia prunastri,* and *Usnea barbata. C. rangiferina* is also used for stuffing pillows for babies and adults by the Lapps*; while at one time, if not still, *A. jubata* was (or is) employed in the Scotch highlands as a stuffing for mattresses. Travellers occasionally bear testimony to the softness of *C. rangiferina* as "a natural and luxurious mountain couch"†. Occasionally too it forms at least an ingredient in the food of man. In the Museum of Economic Botany at Kew there is a specimen of so-called "lichen bread," presented by the Earl of Clarendon, which is used by the people of Finland in times of famine. This bread resembles Rape cake or the black bread of Northern Europe, and contains among its ingredients probably a certain proportion of this lichen and *Cetraria Islandica*, whose claims to be considered a nutrient are less questionable. Second only in importance to the "Reindeer Moss" is the "Iceland Moss" of commerce (*Cetraria Islandica*)—a lichen which, its name notwithstanding, is not only more plentiful, but more largely developed in all its varieties and forms, in Norway than in Iceland. It is in the former country, moreover, and not the latter, that it is almost exclusively collected for the European market, including even Scotland and Färö. In Iceland, however, it is still largely gathered for home consumption, and is a regular article of food for man. Gould, one of the most recent travellers in Iceland, says it is generally added to milk-curd ("skyr"), having first been chopped small, then soaked in water for twenty-four hours, and lastly boiled in milk. This addition does not improve, in his opinion, the flavour of the curd; but the lichen or its extract has in milk, he says, "a pleasant grassy taste"‡. Commander Forbes, too, speaks of having, near Stadahraun, in the Myre Syssel, had a supper, in which "Iceland moss, stewed to a jelly in milk and eaten with cream, formed one of the principal and far from disagreeable dishes"§. Their taste must, to say the least, be peculiar, who go the length, with Kerguelen, of describing "Iceland moss" as preferable to any kind of flour, and as affording "a noble feast!"

In this country and on the continent, "Iceland moss" appears to be used to a considerable extent, in various forms, as a dietetic medicine, or as an article of the Materia Medica. If we are to

* Norway and its Glaciers, by Prof. Forbes, (Edinburgh, 1853) p. 73.

† Williams's 'Through Norway with a Knapsack.'

‡ Iceland: its Scenes and Sagas, by Sabine Baring Gould (London, 1863).

§ Iceland: its Volcanoes, Geysers, and Glaciers, (London, 1860) p. 184.

believe the advertisements, it forms an ingredient of a well-known form of cocoa, "Iceland-moss Cocoa," so-called*, as well as of a French confection, "Pâte de Lichen"†. The article known as "Iceland-moss Cocoa" I have myself largely used with pleasure and benefit. The substance is, however, by no means new; for Sir George Mackenzie mentions having had the combination of Iceland moss and chocolate served to him in Reykjavik in 1810. "We found it," says he, "to be remarkably good, but could not distinguish the addition of the lichen"‡—an experience which has always been my own in regard to the commercial article. Some effectual means in these cases must be adopted to remove or destroy the bitter cetrarine, if, in the commercial article, the lichen is really represented at all.

"Iceland moss" still holds its place in our Government Materia Medica§; it is familiar to all our druggists, though it is comparatively seldom, so far as I can discover, actually used in medical practice in this country. My note-book, however, contains records of its employment both in British and continental hospital-practice, mostly in affections (of a chronic character) of the mucous membrane of the lungs or bowels (catarrh, pneumonia, dyspepsia, diarrhœa, &c.). Even in recent times it has been commended by medical writers as a useful nutrient, demulcent, and tonic. That it really does possess such properties is shown by its chemical constitution; but that it is excelled by numerous other articles of diet or Materia Medica, whether as a nutrient, demulcent, or tonic, or as any combination of two or more of these, there can be little doubt. *Cetraria Islandica* has been shown by chemists to contain only 1 per cent. of nitrogenous material (gluten); but it contains no less than 47 per cent. of lichenine (a form of starch) and cetrarine (a bitter principle), with 3 per cent. of sugar and 10 per cent. of gum and extractive. Viewed in another way, it contains of

Flesh-forming (nitrogenous) material	1 per cent.
Heat-giving (carboniferous) material	50 ,,

Its usefulness as an article of diet, or of the Materia Medica,

* Dunn and Hewett's, 1866.

† Christien's, 1861.

‡ Page 90, original work (Travels in the Island of Iceland during the Summer of the year 1810: Edinburgh, 1811).

§ The recently published official 'British Pharmacopœia;' and in the 'Companion' thereto by Squire, (1864) p. 55.

must thus depend mainly on its lichenine or starch. Its demulcent material is considerable; but its bitter (tonic) and its purely nutrient (nitrogenous) material are insignificant. The lichenine is easily extracted by boiling in water or milk, forming on cooling a firm jelly, similar to that yielded by "carrageen," or "Irish moss" (*Chondrus crispus*, Lyngb., N. O. *Algæ*).

A similar jelly-forming starch, conjoined unfortunately with a similar purgative and nauseous bitter, is contained in the *Umbilicariæ*, the "Tripe de roche" of Arctic voyagers. Various of the commoner species of the genus *Umbilicaria* are employed like *Cetraria Islandica* to yield an edible jelly, and are also ground into a black meal or flour as an ingredient of bread in times of famine, in Arctic parts both of Europe and America. The Canadian hunters have long used the "Tripe de roche," in some form, as an article of food. To the readers of narratives of arctic adventure*, its name is only too familiar as having over and over again formed the sole food of the intrepid traveller.

In British Columbia, "when all other food fails, the natives make shift with a species of lichen which is found in abundance on the sides of the rock"†. This is probably some species of *Umbilicaria*. But in the same country another lichen, a corticolous one, the common wide-spread *Alectoria jubata*, seems an even more familiar article of food. Commander Mayne describes it as "one of the most important articles of food" of the native Indians. It grows abundantly about Kamloops on pine trees. In preparing it for use, the Indians carefully clear away all the fragments of bark, or twig, with which it is collected or intermixed; they then steep it in water till it is quite soft (or flaccid), then wrap it up in grass and leaves to prevent its being burnt, and cook it between hot stones, as savages in all parts of the world are, or have been, in the habit of cooking food. They also boil it and press it into cakes 3–4 inches thick, which look like gingerbread‡. The taste of these cakes is represented, doubtless most truthfully, as "very earthy and rather bitter."..."Our companion

* *Vide* the Narratives by Sir John Franklin and Sir John Richardson, and Lieutenants Back and Wood, of their Expedition down the Coppermine River in Arctic America in 1819–20.

† Cariboo Goldfields, by W. C. Hazlitt, (London, 1862) p. 49.

‡ Compare this description with that of the "Lichen-bread" of Scandinavia, in which *Cladonia rangiferina*, *Cetraria Islandica*, species of *Umbilicaria*, and perhaps of *Alectoria*, *Evernia*, &c. are ingredients, but only ingredients (*vide* p. 411).

St. Paul," says Commander Mayne, "gave us this (food), which they (the Indians) call 'Wheela' (or 'Whyelkine'), with milk . . . . . But two or three mouthfuls were all we cared to take"*. Other lichens are used as food by the same Indians, sometimes in addition to, but more generally in the absence of, the salmon, venison, bear, and wild sheep,—the berries and the mosses, which form their usual and staple food.

It would appear that in North European countries, wherever the inhabitants still weave home-grown wool into cloth-stuffs, the use of lichens as dye-agents of the wool or yarn also still exists. In Färö, for instance, *Lecanora tartarea* is still largely used for dyeing the home-made woollen cloth called "wadmal"†, whereof the Färöese fashion their jackets, trousers, and petticoats. During my own visit to Färö in 1860, I found abundant evidence of the collection of this and apparently also the allied species, *L. parella*, with their sterile and isidioid or variolarioid conditions, for economical purposes, inasmuch as all the boulders and rocks about Thorshavn bore the marks of a periodical careful scraping of the lichens in question. My friend Mr. Symington ‡ mentions that the inhabitants of Fair Isle, thirty miles south-west of the Shetland group, use lichens (he does not say what species) for dyeing the wool of which they make their vestments. Similar use is probably still made of various lichens, especially *Lecanora tartarea* and *Parmelia saxatilis*, in the more remote parts of the Scottish highlands and islands, and even of Wales §. Prof. Blytt informed me that *L. tartarea* and *L. ventosa* are still collected in the Bergenstift of Norway for export to France (for the orchil-manufacture). There is probably some error as to the latter lichen, which has never, so far as I am aware, been employed as a dye-agent, and which neither contains nor yields orchil.

In continuation of a series of experiments conducted between 1850 and 1852 ||, I have examined certain of the Icelandic, Färöese, and Norwegian lichens which in these or other countries yield

* 'Four Years in British Columbia and Vancouver Island,' by Commander R. C. Mayne, R.N., F.R.G.S., (London, 1862) p. 122.

† On the authority of Sysselman Müller in 1854. *Vide* 'Cruise of the yacht Maria among the Färö Islands in the Summer of 1854,' (London, 1855) p. 46.

‡ Sketches of Färö and Iceland, 1862, p. 8.

§ On the authority of Mr. Pamplin, of London, the well-known botanical bookseller.

|| "Experiments on the Dyeing Properties of Lichens," Edinburgh New Philosophical Journal, October 1854 and July 1855.

red dyes, and in contrast with them the same species from New Zealand, India, and other parts of the world, in order to determine approximately and roughly how far climatic and other differences affect their colorific property. The northern lichens experimented on were mostly :—

1. *Lecanora tartarea*, Ach.
2. *L. parella*, Ach.
3. *Parmelia saxatilis*, Ach.
4. *Umbilicaria erosa*, Hffm.
5. *Ramalina scopulorum*, Ach.

The general result was, that the same colour, with certain differences in quality or intensity, was yielded in all cases by the same species, from whatever country derived, the circumstances of experiment being virtually the same in all. Such results, however, of experiments conducted on the small scale cannot be in all senses relied on. They appear, for instance, opposed to the fact that orchil-manufacturers are guided by their experience to prefer "orchella weed" (species of *Roccella*) from equatorial or subequatorial maritime regions; under which circumstances of growth the same species is found to be richer in colouring-matter than when it is collected from higher latitudes and more inland localities. As the result of all my inquiries and experiments on the subject since 1850, I have little doubt that latitude, climate, temperature, moisture, exposure, elevation, geological character of the soil, nature of the trees on which they grow, and in general all those conditions which affect the botanical character of the plant (and the genus *Rocella* is one of the most variable in the whole lichen-family) also affect their chemical character, and so render the *Roccellæ* more or less serviceable for the purposes of the colour-manufacturer or dyer.

It is here worthy of remark that the natives of tropical or subtropical countries which abound in valuable dye-lichens, who export them largely for the European market, are yet themselves ignorant of their uses and value. For instance, my friend Dr. Kirk informs me that large quantities of certain corticolous maritime *Roccellæ* (probably *R. Montagnei*, Dél., or various forms of *R. fuciformis*, Ach., to which I am disposed to refer *R. Montagnei* as a mere variety) are exported regularly from Zanzibar, Eastern Africa, partly *viâ* Bombay, but in great measure directly to Portugal and France. These are by far the most valuable dye-lichens known, and they have gradually supplanted, in the British market at least, all other species and genera. Yet, says Dr. Kirk, they are un-

known to the natives in the Zambesi and Zanzibar districts as being capable of yielding dyes, or of being otherwise utilized in the domestic arts. Nor could I find any trace in New Zealand or Australia of the application by the natives of lichens in dyeing or otherwise. On the other hand, their use seems to be abundantly recognized in India—my friend Mr. Cooke, of the India Museum, having some years ago submitted to me for examination a series of specimens, embracing several genera as well as species, of lichens which are currently used by the natives as dye-givers†.

List of Diatomaceæ collected by Dr. David Lyall, R.N., of the N.W. Coast of British North America Boundary Commission, 1858–59. By F. KITTEN, Esq. Communicated by Dr. HOOKER, F.R.S.

[Read Nov. 1, 1866.]

THE Algæ and Zoophytes collected by Dr. D. Lyall during the survey of the north-west coast of British North America (extending from Fort Colville to the Rocky Mountains) are in many instances thickly invested with filamentous and stipitate Diatomaceæ. The most abundant is *Isthmia nervosa*: in many specimens its growth has extended nearly half an inch from the surface of the Alga or Zoophyte to which it was attached. The next in abundance is *Triceratium arcticum*, in filaments: this species was first found concatenate on zoophytes from Vancouver's Island; and an able paper upon it, by F. C. S. Roper, Esq., F.L.S., will be found in the Transactions of the Microscopical Society of London, vol. viii. p. 55. Specimens of Algæ from Fuca Strait were also thickly covered with *Rhabdonema minutum*, *Podosphenia gracilis* and *P. Ehrenbergii*.

The * denotes that the specimens occur very rarely.

* *Arachnoidiscus Ehrenbergii.*
Biddulphia Roperiana.
Cocconeis scutellum, small form.
Fragilaria striatula.
* *Grammatophora marina.*
* *Gomphonema*, sp. ?
* *Hyalodiscus (Podosira ?) subtilis.*

† *Vide* paper "On the Dye-stuffs of India and China," in the 'Technologist,' 1861, vol. i. pp. 136–138; and "Waste Products and Undeveloped Substances," by P. L. Simmonds, (London, 1862) p. 264.

Isthmia nervosa.
* *Melosira nummuloides.*
* *Pleurosigma minutum.*
Podosphenia Ehrenbergii.
—— *gracilis.*
Podosira hæmoides.
Rhabdonema minutum.
Synedra affinis.
* —— *investiens.*
* —— *salina.*
Schizonema Grevillii.
Triceratium arcticum.
* —— ——, var. β.

The above-named species are all from Esquimalt Harbour and Fuca Strait. With five exceptions, they are all British species.

An Account of the *Sclerotium stipitatum* (Berk. et Curr.) of Southern India. By John Shortt, M.D., F.L.S., M.R.C.P.L., General Superintendent of Vaccination, Madras.

[Read Nov. 1, 1866.]

Scientific name.—*Sclerotium stipitatum* (Berk. et Curr.).

Indian name.—1. Pŭttŭ Manga, from *pŭttŭ*, a white-ant hill, and *manga*, a mango (fruit); literally, white-ant-hill mango.

Synon.—2. Pŭttŭ Kāi, from *pŭttŭ*, white-ant hill, and *kāi*, fruit,—or, white-ant-hill fruit.

3. Mail Manga, from *mail*, dry, like sticks, leaves, &c., and *manga*, a mango,—or, dry mango.

I am indebted to the kindness of Daniel Hanbury, Esq., F.L.S., for drawing my attention to the Pŭttŭ Manga. I have had some experience in exploring the white-ant hills in the Madras district, while carrying out some experiments (the results of which were to be noticed in an Essay on the destructive effects of the White Ant), and in no instance have I met with the Puttu Manga; nor is the substance, or its name, familiar to the natives of the Carnatic. The fact of its not being found in this part of India may be accounted for by the great dryness of the climate in this locality, and the absence of the moisture and heat so necessary for fungoid growths. On the western coast, where it rains for at least six months in the year, the conditions favourable for

the growth of this fungus exist in the burrows or excavations formed by the white ants. The natives state that it is occasionally to be met with in dark crevices, and in the recesses of rocks and caves: my experience does not confirm this latter fact as yet; and the specimens I have now the honour of submitting were all procured from the white-ant hill, or *pŭttŭ.*

These fungoid growths are only met with in old and deserted ant-hills, and frequently after the insects have become winged: they are found only in the peripheral and more superficial caverns, springing from their roof, occasionally from the floor, never from the cells occupied by the ants themselves. Some grow with long stalks, others are sessile; in those having stalks, they can in a few be traced beneath the soil, while the sessile ones seem simply to lie over the soil.

Messrs. Currey and Hanbury are in unison with Mr. Berkeley in the opinion that the Pŭttŭ Manga is of fungoid growth: of this there can be no doubt, from the habitat and structure, as also from the fact that it attains its greatest perfection during, or immediately after, the rains; and it is possible that further research during this particular period may tend to the discovery of a perfect specimen, with the organs of fructification fully developed.

The present specimens were procured in the Coimbatore and Malabar districts, in October 1865, and were removed, some *in situ* attached to the clod of earth, and others loose, from the interior of several white-ant hills, within the caverns of which some were found growing in clusters of six or more, hanging each by a separate stalk, and others simply overlying the floors of the cells, without stalks. Those taken up with the clod of earth soon lost moisture, and crumbled to dust. These, on removal, were not quite so black in colour, and have shrunk considerably in size; and I should say that they are one-third smaller now than when taken out of the white-ant hill.

They take on a variety of forms, being oval, oblong, pyriform, irregularly round, &c. The external rind is black and slightly wrinkled; on cutting into it, the interior is found to be white and pithy, and is compared by the natives to the kernel of a tender cocoa-nut. It is tasteless and inodorous.

The Malayalum Vythians, who are familiar with the Pŭttŭ Manga, believe it to be manufactured by the insects themselves, by a kind of accretive process, and that snakes are very fond of it and devour it greedily. Snake-charmers collect the Pŭttŭ Manga and take it round for sale, and they then give out that they keep a

supply always on hand to feed their snakes with: this assertion I am much inclined to doubt.

Others say that it is not a vegetable product, but a conglomerated mass of the larvæ of white ants. It is not familiar to the generality of natives; and the educated among them are not aware of its existence; whereas it is well known to the rude villagers, who attribute to it poisonous qualities. The various accounts given of its nature and properties differ so much that one hardly knows what degree of reliance to place on them.

The Vythians eagerly seek it, and use it as a remedy in cholera, syphilis, and a variety of other diseases. In cholera it is prescribed as a specific, by rubbing it up with a little water and fresh ginger-juice or country arrack; and the dose is repeated after every motion or act of vomiting.

The natives who assisted in removing the present specimens remarked that they are not full-grown, and that they attain the size of an orange during the monsoons. It is not commonly found in white-ant hills, but is met with in one out of every twenty or thirty on the western coast and Coimbatore district.

I am indebted to my assistant, Mr. W. Harney, for several specimens of the Pŭttŭ Manga, as well as for such information on the subject as he could collect for me in the Coimbatore district.

List of *Cladoniæ* collected in Iceland, Färö, and Norway. By W. Lauder Lindsay, M.D., F.R.S. Ed., F.L.S., &c.

[Read Nov. 1, 1866.]

The following short list is a natural Appendix to my "Contributions to the Lichen-flora of Northern Europe," printed last session*. At the time of presentation of that paper, I was unavoidably compelled to omit the *Cladoniæ*, and I am only now in a position to supply the omission—one which fortunately does not affect any general statements propounded in the "Contributions" in question. With only one exception, the *Cladoniæ* collected were more or less common *British* forms; they were mostly terricolous, though a few were also saxicolous or corticolous (the latter among Norwegian specimens).

The lichens catalogued in the following list have had the advantage of being examined and named by my friend Mr. Mudd, of

* Journ. of Linnean Society, (Botany) vol. ix. 1865, p. 365.

Cambridge, while preparing his "Monograph of British Cladoniæ" (1865).

These northern *Cladoniæ* illustrate well that *continuity of variation* among Lichens which too frequently renders the limitation or definition of varieties or species (sometimes even of genera and families) impossible; whence it follows that all efforts to name every apparently distinct condition are futile, and the results of such efforts mischievous, as embarrassing the student in the mazes of a hopelessly confusing synonymy. In plants so variable, it seems to me much better to establish comprehensive general groups, regarding which some unanimity of opinion among lichenologists may reasonably be looked for (indicating the chief directions or forms of variation only, without describing even these by special names) rather than to distinguish every shade of difference as a named form, state, condition, or subvariety. Until the present mania for species-splitting and name-giving, and for the expiscation of minute, trivial, and too generally inconstant anatomical *differences* is superseded by a classification based upon broad general *resemblances*, it is vain to expect lichenology to become either intelligible or attractive to the student.

I. *Iceland.*

1. *Cladonia cervicornis*, Ach.
   Var. *verticillata*, Ach., Th. Fries, Lich. Arctoi.
2. *C. rangiferina*, L.
   Subvar. *sylvatica*, Hffm. Moors behind Reykjavik.
3. *C. coccifera*, L.
   Subvars. *cornucopioides*, Ach., and *extensa*, Hffm. Laugarness Moors.

II. *Färö* Islands.

1. *Cladonia cervicornis*, Ach. Hills behind Thorshavn: more abundant than any other species of *Cladonia*.
2. *C. pyxidata*, L. Various forms, seldom fertile, generally deformed: on old walls of sheep-pens, associated with *C. furcata*.
3. *C. furcata*, Huds. Various forms, generally sterile: on old walls of sheep-pens.
   Var. *racemosa*, Flk. Hills behind Thorshavn.
   Var. *subulata*, L., subvar. *cymosa*, Flk. Hills behind Thorshavn.
4. *C. rangiferina*, L. More plentiful than *C. pyxidata*.
5. *C. stellata*, Schær.
   Var. *adunca*, Ach. Hills behind Thorshavn.

6. *C. coccifera*, L.
Subvars. *cornucopioides*, Ach., and *extensa*, Hffm. Hills behind Thorshavn.

III. *Norway.*

1. *Cladonia cervicornis*, Ach. Christiansand.
2. *C. pyxidata*, L.
   1. Var. *cornuta*, Ach., subvar. *vulgaris*, Coëm. Jerkin, Fogstuen, and other parts of the Dovrefjeld.
   2. Var. *chlorophæa*, Flk., subvar. *vulgaris*, Coëm. Sneehätten. Subvar. *simplex*, Mudd. Haalangenfjeld.
3. *C. gracilis*, L., subvar. *chordalis*, Flk. Top and flanks of Sneehätten; Jerkin; Fogstuen. Common on the Dovrefjeld, both in fruit and spermogoniferous.
   1. Var. *hybrida*, Ach. Fogstuen: sterile.
   2. Var. *macroceras*, Flk. Haalangenfjeld: abundant, both fertile and sterile.
4. *C. degenerans*, Flk., subvar. *phyllophora*, Ehrh. Haalangenfjeld.
Subvar. *euphorea*, Flk. Jerkin. Common: spermogoniferous.
5. *C. botrytes*, Hffm. Corticolous: Christiania, very common (*Blytt*).
6. *C. furcata*, Huds., var. *racemosa*, Flk. Haalangenfjeld.
7. *C. rangiferina*, L. Sneehätten. Jerkin: spermogoniferous.
Subvar. *grandis*, Flk. Christiansand; Jerkin; abundant on the Dovrefjeld.
Subvar. *alpestris*, Ach. Jerkin: common.
Subvar. *sylvatica*, Hffm. Haalangenfjeld; Jerkin, in fruit.
8. *C. stellata*, Schær., var. *adunca*, Ach. Haalangenfjeld.
Subvar. *turgescens*, Fr. Jerkin: common, occasionally spermogoniferous.
9. *C. amaurocræa*, Flk., subvar. *dicræa*, Ach. Falls of the Rauma, Romsdal (dwarf form); Haalangenfjeld; Sneehätten; Fogstuen; Jerkin: common in fruit and sterile, associated with *Peltigera aphthosa*, Hffm.
10. *C. coccifera*, L., subvars. *cornucopioides*, Ach., and *extensa*, Hffm. Haalangenfjeld; Sneehätten; common on the Dovrefjeld; Jerkin (*Drs. Anderson and Gilchrist*).
   1. Var. *macilenta*, Hffm., subvar. *polydactyla*, Flk. Jerkin.
   2. Var. *bellidiflora*, Ach. Top of Sneehätten.
   3. Var. *deformis*, L. Haalangenfjeld. Top of Sneehätten; Fogstuen; Jerkin; common on the Dovrefjeld.
Subvar. *pleurota*, Flk. Fogstuen; Jerkin.

Summary.	Iceland.	Färö.	Norway.
1. *Cladonia cervicornis*, Ach.	....	1	1
1. Var. *verticillata*, Ach.	1		
2. *C. pyxidata*, L.	....	1	
2. Var. *chlorophæa*, Flk.			
1. Subvar. *vulgaris*, Coëm.	....	....	1
2. —— *simplex*, Mudd.	....	....	1
3. Var. *cornuta*, Ach.			
3. Subvar. *vulgaris*, Coem.	....	....	1
3. *C. gracilis*, L.			
4. Subvar. *chordalis*, Flk.	....	....	1
4. Var. *macroceras*, Flk.	....	....	1
5. —— *hybrida*, Ach.	....	....	1
4. *C. degenerans*, Flk.			
5. Subvar. *phyllophora*, Ehrh.	....	....	1
6. —— *euphorea*, Flk.	....	....	1
5.* *C. botrytes*, Hffm.	....	....	1
6. *C. furcata*, Huds.	....	1	
6. Var. *racemosa*, Flk.	....	1	1
7. —— *subulata*, L.			
7. Subvar. *cymosa*, Flk.	....	1	
7. *C. rangiferina*, L.	....	1	1
8. Subvar. *grandis*, Flk.	....	....	1
9. —— *alpestris*, Ach.	....	....	1
10. —— *sylvatica*, Hffm.	1	....	1
8. *C. stellata*, Schær.			
8. Var. *adunca*, Ach.	....	1	1
11. Subvar. *turgescens*, Fr.	....	....	1
9. *C. amaurocræa*, Flk.			
12. Subvar. *dicræa*, Ach.	....	....	1
10. *C. coccifera*, L.			
13. Subvar. *cornucopioides*, Ach.	1	1	1
14. —— *extensa*, Hffm.	1	1	1
9. Var. *macilenta*, Hffm.			
15. Subvar. *polydactyla*, Flk.	....	....	1
10. Var. *bellidiflora*, Ach.	....	....	1
11. —— *deformis*, L.	....	....	1
16. Subvar. *pleurota*, Flk.	....	....	1
Total species	....	4	3
„ varieties	1	2	6
„ subvarieties	3	3	15
	4	9	24
		37	

* Not British.

On some new *Fungi* from Mexico.

By the Rev. M. J. BERKELEY, M.A., F.L.S.

[Read Nov. 15, 1866.]

[PLATE XII.]

A SMALL collection of Fungi, made by Signor Botteri in Mexico, near Orizaba, was lately forwarded to the Rev. M. A. Curtis, of Hillsborough, North Carolina, by the Smithsonian Institution. The specimens have kindly been submitted to me; and I find one or two so interesting that I think no time should be lost in laying before the Linnean Society a short description of them, to which I have added characters of the other new species in the collection. The information I have received is so scanty that I am unable to say anything about their habits, and must therefore confine myself to a mere description. One of them undoubtedly belongs to a new genus, which I have dedicated to Mrs. Lloyd Wynne, who has made an especial study of the Fungi of Denbighshire, and has added many interesting species to our flora.

1. PAXILLUS LIGNEUS, *Berk. & Curt.* Pileo conchiformi, ligneo, tomentoso, luteo, margine involuto; lamellis angustis, postice reticulatis; sporis fuscis.

Very hard when dry, but brittle towards the margin. Pileus 2½ inches long and broad; spores nearly as broad as long, subcymbiform with a large nucleus.

Allied to *Paxillus pannoïdes*.

2. TRAMETES MEXICANA, *Berk. & Curt.* Pileo ungulato, inæquabili, subtomentoso, fusco, marginem versus pallidiore umbrino, contextu suberoso pallido; sporis non stratosis, majusculis, subrotundis, acie obtusis, brunneolis.

Pileus 1⅛ inch long, 3½ inches broad.

I cannot point out any immediate ally of this species.

3. CRATERELLUS CONFLUENS, *Berk. & Curt.* Aurantiacus; pileis dense connatis, profunde infundibuliformibus; venis conspicuis, reticulatis, decurrentibus.

Pilei 2 inches high, 1 inch across, margin incurved; stem divided above into numerous pilei, deeply grooved when dry.

Allied to *Craterellus luteus*, but differs in habit, and in the more conspicuous veins.

In the same collection are specimens of *Craterellus cantharellus*, Schweinitz, a species hitherto not found out of the United States.

4. HYMENOGASTER MICROSPORUS, *Berk. & Curt.* Globosus, albus,

tener, extus verruculosus, intus luteus, demum sordide umbrinus; sporis minutis, ellipticis; nucleo distincto.

This curious species has a distinct base, and a slightly warty peridium, thus approaching *Lycoperdon*, to which genus it would have been referred had not the spores been perfectly developed, or had there been any trace of flocci, which are conspicuous even in a young *Lycoperdon*. The peridium is scarcely half an inch across. In habit it closely resembles *Arachnion album*.

WYNNEA, *Berk. & Curt.*, novum genus.

Cupulis elongatis auriformibus coriaceis, sursum divisis, basi in stipitem plus minus distinctum connatis.

5. WYNNEA GIGANTEA, *Berk. & Curt.* Stipite communi subcylindrico, crasso, rugoso, suberoso, intus albo, sursum ramoso, in cupulas auriformes multiplices quandoque proliferas diviso; cupulis extus glabris, marginibus inflexis, cum hymenio rufis; sporidiis magnis, subcymbiformibus.

Common stem 3 inches high, $\frac{3}{4}$ inch thick, deeply rugose and cracked, so that the surface resembles that of some *Opegraphæ*; above divided repeatedly, with subdivisions elongated into ear-shaped cups, which are smooth externally, but wrinkled, though not cracked like the stem when dry; the cups are from $2\frac{1}{2}$ to 3 inches long, with incurved margins variously divided, and sometimes proliferous. Asci cylindrical, containing eight subcymbiform sporidia, ·00095 inch long, and more or less obtuse at either end. When steeped in water, the inside of the stem acquires a slight foxy tinge, and the water is deeply coloured.

The substance is so totally different from that of *Peziza*, though this curious fungus is closely allied to *Peziza leporina* and *P. onotica*, that it cannot be placed in the same genus. *Peziza macrotis*, Berk. in Hook. Journ. of Bot. vol. iii. p. 203, a species found abundantly at Darjeeling, at 7500 feet, is clearly congeneric, and may be characterized *Wynnea macrotis*, Berk., cupulis basi connato-ramosis hepaticis, hymenio purpurascente.

The Darjeeling species grows on rotten wood; but there is no information as to the place of growth of the Mexican species.

TAB. XII. *Wynnea gigantea*, natural size.

a. Ascus magnified. *b.* Sporidia more highly magnified.

6. HYPOMYCES INSIGNIS, *Berk. & Curt.* Rubra; mycelio effuso; peritheciis oblongis saturate coloratis, ostiolis nidulantibus; sporidiis fusiformibus, utrinque apiculatis.

Covering with a uniform deep rose-red stratum the hymenium

and pileus of some *Cantharellus*, of which it almost obliterates the gills. The fungus had evidently been broken off before it was attacked by the parasite, as the fractured surface is equally infested with the rest of the plant. The mycelium does not penetrate deeply into the substance of the matrix. The sporidia are ·0015 inch long, with the endochrome divided into two distinct parts. Sometimes they are sigmoid with a row of nuclei.

TAB. XII. fig. *c*. Sporidia, highly magnified.

An Enumeration of the Indian Species of *Acanthaceæ*. By THOMAS ANDERSON, M.D., F.L.S., Superintendent of the Royal Botanical Gardens, Calcutta.

[Read Nov. 1, 1866.]

I COMMENCED the examination of this order in 1859, by arranging and determining the species contained in Griffith's, Helfer's, and Falconer's Herbaria, recently distributed from the Royal Gardens, Kew. About the same time, I described the Ceylon species for Mr. Thwaites's enumeration of Ceylon plants. Before I left Kew to return to India, in 1861, I had examined all the Indian species in the Kew herbarium, and named and described many of the new ones. On my arrival in Calcutta, I found the herbarium of the Calcutta Botanical Gardens exceedingly rich in specimens of this order; while several new species, which I had not seen in London, were discovered in the collections of plants by Masters, Simons, Jenkins, and others, deposited in this herbarium. With the exception of the Hookerian-Thomsonian herbarium, none of the specimens were determined; and thus the examination of all the Indian species had to be undertaken again.

My original intention was to include in this enumeration all the Asiatic species of *Acanthaceæ*, in the same manner as I enumerated the African species in the paper I published in the seventh volume of the Society's Proceedings. The want of specimens from Java and the Malayan archipelago forced me to abandon this plan, and I have therefore restricted myself, for the present, to the elucidation of the *Acanthaceæ* of India. Through the kindness of Professor Miquel, who has sent me the *Acanthaceæ* of the Leyden herbarium for examination, and of my friend Mr. Teijsmann, the Director of the Botanical Gardens of Buitenzorg, who has supplied me with specimens of all the *Acanthaceæ* existing in the herbarium of the gardens under his

charge, I hope soon to contribute some notes on the Asiatic species not included in this enumeration.

Until I have had an opportunity of examining the American species, it would be premature to speak of the characters and affinities of the genera. Still I think that the limits of the Asiatic genera and the larger groups, such as suborders and tribes, will not be materially altered when the entire order is revised.

The views I have adopted concerning the limits and relations of the genera to each other, and the grouping of them into tribes and suborders, are essentially different from those of Nees von Esenbeck. His division of the order into two suborders by the nature of the placental processes of the seed is exceedingly unequal, as (after the separation of the very small abnormal group, the suborder *Anechmatacantheæ*) the true representatives of the order, though styled the second suborder *Echmatacantheæ*, remain in reality as an order of great extent. In the arrangement of the order which I proposed first in Mr. Thwaites's enumeration of Ceylon plants, I removed the suborder *Thunbergideæ* from my suborders *Ruellideæ* and *Acanthideæ* by the nature of the calyx, the æstivation of the parts of the corolla, and the peculiar processes which support the seeds. The remaining suborders, *Ruellideæ* and *Acanthideæ*, almost coextensive with Nees's suborder *Echmatacantheæ* (he includes *Nelsonia* in *Anechmatacantheæ*), are readily distinguished from each other by the æstivation of the corolla, which is strongly contorted in *Ruellideæ* and imbricated in *Acanthideæ*.

In *Ruellideæ* I have established the tribes on characters taken principally from the calyx and the form of the seed; in *Acanthideæ* I have found that the tribes are easily distinguished by the form of the corolla, the number of the stamens, and the condition of the anthers. The groups of genera which I have called subtribes are based on characters found in the parts of the flower, or in the form of the capsule, and the number of the seeds, as these happen to vary in the tribes to which these lower groups belong. The synonyms I have quoted in many parts of this enumeration, and the short generic characters given in the Conspectus Generum, show how greatly Nees von Esenbeck's genera have been altered, and in many cases suppressed. In this enumeration, and also in that of the African species, I have restored Linnæus's two important genera *Ruellia* and *Justicia*, both of which had been virtually destroyed by Nees; for although

the names were left, nearly all the species placed in those genera by Linnæus, Vahl, and other authors were removed to new genera. *Ruellia*, as constituted by Nees, is composed of species which, in my opinion, must be removed to *Hemigraphis*, a small genus almost confined to the Malayan peninsula and archipelago and the Philippine islands, while *Dipteracanthus* of Nees was composed by him of the true species of *Ruellia*. *Justicia* fares even worse than *Ruellia*, as the only plants retained in it by Nees are mere varieties of one widely diffused species, *Justicia Ecbolium*, Linn., which after all is not a *Justicia* but an *Eranthemum*, *E. Ecbolium*, T. Anders. These genera thus restored to their proper position, become the largest genera in their respective suborders.

The general geographical distribution of *Acanthaceæ* was discussed by Frankenheim in a paper he published in the Linnæa for 1848. Nees von Esenbeck's monograph of the order, in De Candolle's Prodromus, formed the basis from which the deductions were drawn. The tables Frankenheim gave for the distribution of the order in India are almost of no value, as the geographical divisions he adopted cannot be accepted as natural by any one acquainted with the physical features of the Indian continent.

In attempting to illustrate the geographical distribution of *Acanthaceæ* in India I have divided the region into nine provinces:—1. Ceylon. 2. The western peninsula, including that part of India south of a line drawn from the mouth of the Goddavery to that of the Nerbudda. 3. Central India, comprising the country between the northern boundary of the western peninsula and the Gangetic valley; Orissa, Berar, Malwa, and the southern portion of Behar and Bundelcund are comprised in this division. 4. The lower Gangetic plain, which term I apply to the flat alluvial plain through which the Ganges and its tributaries flow. This province extends to the base of the Himalaya on the north, on the east to the Teesta and Brahmaputra, on the south to the sea and the northern boundary of what I have regarded as Central India, on the west to a line passing through the longitude of Benares. 5. Northern Hindostan, in which I have comprehended the upper Gangetic plain, the Punjaub, and Scinde. 6. The Himalaya mountains. 7. Eastern Bengal, comprehending the countries to the east of the eastern boundary of the lower Gangetic plain, comprising Assam, the Khasia, and the neighbouring hill ranges, Cachar, Tipperah, and Chittagong. 8. Burmah, the Tenasserim provinces and the Andaman Islands. 9. Malayan peninsula. The boundary

between these last two divisions is the southern limit of the Tenasserim provinces, a little south of Mergui.

The distribution of the *Acanthaceæ* in these provinces is shown by the following table, which indicates the geographical distribution of the 374 species contained in this enumeration:—

TABLE showing the Geographical Distribution of the Species of Acanthaceæ in India.

	Ceylon.	Western Peninsula.	Central India.	Lower Gangetic Plain.	Northern Hindostan.	Himalaya.	Eastern Bengal.	Burmah.	Malayan Peninsula.	Distribution out of India.
Thunbergia grandiflora	...	1	1	1	1	1	1	...	...	
—— laurifolia	...	...	...	...	...	...	...	1	...	
—— Hawtaynii	1	1	...	...	...	...	...	...	...	
—— lutea	...	...	...	...	...	1	...	...	...	
—— coccinea	...	...	...	...	...	1	1	...	...	
—— Mysorensis	...	1	...	...	...	...	...	...	...	
—— Wightiana	...	1	...	...	...	...	...	...	...	
—— fragrans	1	1	...	...	..	1	...	1	...	Java, Philippines.
—— tomentosa	...	1	...	...	...	...	...	...	...	Africa.
Elytraria crenata	1	1	1	1	1	...	...	...	...	America.
Nelsonia tomentosa	1	1	1	1	1	1	1	1	...	Africa, America, Australia.
Ebermaiera glauca	1	1	1	1	1	...	1	1	...	Java, Philippines. Australia.
—— humilis	...	...	...	...	...	...	...	1	...	
—— Zeylanica	1	1	...	...	...	...	...	1	...	
—— Staurogyne	...	...	...	...	...	...	1	...	1	
—— angustifolia	...	...	...	...	...	...	...	1	...	
—— argentea	...	...	...	...	...	...	1	...	...	
—— setigera	...	...	...	...	...	...	...	...	1	
—— longifolia	...	...	...	...	...	...	...	...	1	
—— Simonsii	...	...	...	...	...	...	1	...	...	
—— velutina	...	...	...	...	...	...	...	1	...	
—— axillaris	...	...	...	...	...	...	...	...	1	
—— Griffithiana	...	...	...	...	...	...	...	...	1	
—— Helferi	...	...	...	...	...	...	...	1	...	
—— lasiobotrys	...	...	...	...	...	...	...	1	...	
—— elongata	...	...	...	...	...	...	...	...	1	
—— racemosa	...	...	...	...	...	...	...	...	1	
—— Merguensis	...	...	...	...	...	...	...	1	...	
—— gracilis	...	...	...	...	...	...	...	1	...	
—— obtusa	...	...	...	...	...	...	...	1	...	
—— paniculata	...	...	...	...	...	...	1	1	...	
—— McClellandi	...	...	...	...	...	...	...	1	...	
Adenosma balsamea	1	1	...	...	...	...	...	...	...	
—— verticillata	1	1	...	...	...	...	...	...	...	
—— biplicata	...	...	...	...	...	...	...	1	...	
—— triflora	...	...	...	1	1	...	1	...	1	Feejee Islands.

Table (*continued*).

	Ceylon.	Western Peninsula.	Central India.	Lower Gangetic Plain.	Northern Hindostan.	Himalaya.	Eastern Bengal.	Burmah.	Malayan Peninsula.	Distribution out of India.
Adenosma Thymus	...	1	...	...	...	...	...	...	...	
—— Griffithii	...	...	...	1	...	...	1	...	...	
—— pinnatifida	...	1	...	...	...	...	...	...	...	
—— uliginosa	1	1	...	1	...	1	1	...	...	Java.
—— Thwaitesii	1	...	...	...	...	...	...	...	...	
Nomaphila Parishii	...	...	...	...	...	...	...	1	...	
Hygrophila polysperma	...	1	1	1	1	1	1	1	1	
—— Serpyllum	...	1	1	...	...	...	...	...	...	
—— salicifolia	1	1	1	1	1	...	1	1	1	Java, Philippines, China, Japan, Australia.
—— spinosa	1	1	1	1	1	1	1	1	...	Tropical Asia and Africa.
Cystacanthus paniculatus	...	...	...	...	...	...	...	1	...	
—— cymosus	...	...	...	...	...	...	...	1	...	
Echinacanthus attenuatus	...	...	...	...	...	1	1	...	...	
—— parviflorus	...	...	...	...	...	...	1	...	...	
Calophanes vagans	...	1	...	...	...	...	...	...	...	
—— Nagchana	...	...	...	1	...	...	...	...	...	
—— depressa	1	1	1	...	...	...	...	...	...	
—— littoralis	1	1	...	...	...	...	...	...	...	Java.
Ruellia repens	1	...	...	...	...	...	...	1	1	Java, Philippines, China.
—— prostrata	1	1	1	1	1	...	...	1	...	Java, East Africa.
—— patula	1	1	...	...	...	...	...	...	...	Arabia, Africa, Java.
—— longifolia	...	...	...	...	1	...	...	...	...	
—— cernua	...	...	1	...	...	...	...	...	...	
—— ciliata	...	...	...	...	...	...	...	1	...	
—— suffruticosa	...	...	...	1	1	...	...	...	...	
Petalidium barlerioides	...	1	1	...	...	1	...	...	...	
Phaylopsis parviflora	1	1	...	1	...	...	1	1	...	Senegambia, Madagascar.
Hemigraphis dura	...	1	...	...	...	...	...	...	...	
—— hirta	...	...	...	1	1	1	...	...	...	
—— rupestris	...	1	...	...	...	...	...	...	...	
—— elegans	...	1	1	...	...	1	...	1	...	
—— quadrifaria	...	...	...	...	...	...	...	1	...	
—— Griffithiana	...	...	...	...	...	...	...	1	...	
—— confinis	...	...	...	...	...	...	...	...	1	Java?
Stenosiphonium Zeylanicum	1	...	...	...	...	...	...	...	...	
—— confertum	...	1	...	...	...	...	...	...	...	
—— Russellianum	1	1	...	...	...	...	...	...	...	
—— setosum	...	1	...	...	...	...	...	...	...	
—— parviflorum	...	1	...	...	...	...	...	...	...	
Strobilanthes consanguineus	1	1	...	...	...	...	...	...	...	

Table (*continued*).

	Ceylon.	Western Peninsula.	Central India.	Lower Gangetic Plain.	Northern Hindostan.	Himalaya.	Eastern Bengal.	Burmah.	Malayan Peninsula.	Distribution out of India.
Strobilanthes nigrescens	1	...	...	...	...	...	...	...	...	
—— viscosus	1	1	...	...	...	...	...	...	...	
—— cuspidatus	...	1	...	...	...	...	...	...	...	
—— Kunthianus	...	1	...	...	...	...	...	...	...	
—— rhamnifolius	1	...	...	...	...	...	...	...	...	
—— Gardnerianus	1	...	...	...	...	...	...	...	...	
—— gossypinus	...	1	...	...	...	...	...	...	...	
—— vestitus	1	...	...	...	...	...	...	...	...	
—— Arnottianus	1	...	...	...	...	...	...	...	...	
—— Wightianus	...	1	...	...	...	...	...	...	...	
—— asper	...	1	...	...	...	...	...	...	...	
—— Perrottetianus	...	1	...	...	...	...	...	...	...	
—— eriocephalus	...	1	...	...	...	...	...	...	...	
—— anceps	1	1	...	...	...	...	...	...	...	
—— adenophorus	1	...	...	...	...	...	...	...	...	
—— scaber	1	...	...	...	...	...	1	1	...	Timor?
—— roseus	...	...	...	...	...	...	...	1	...	
—— crispus	...	...	...	...	...	...	...	1	...	Java.
—— glaucescens	...	...	...	...	...	...	...	1	...	
—— sessiloides	...	1	...	...	...	...	...	...	...	
—— sessilis	...	1	...	...	...	...	...	...	...	
—— Zenkerianus	...	1	...	...	...	...	...	...	...	
—— foliosus	...	1	...	...	...	...	...	...	...	
—— tetrapterus	...	1	...	...	...	...	...	...	...	
—— barbatus	...	1	...	...	...	...	...	...	...	
—— ciliatus	...	1	...	...	...	...	...	...	...	
—— papillosus	...	1	...	...	...	...	...	...	...	
—— micranthus	...	1	...	...	...	...	...	...	...	
—— laxus	1	...	...	...	...	...	...	...	...	
—— luridus	...	1	...	...	...	...	...	...	...	
—— lupulinus	1	1	...	...	...	...	...	...	...	
—— calycinus	1	...	...	...	...	...	...	...	...	
—— Hookeri	1	...	...	...	...	...	...	...	...	
—— Andersonii	...	1	...	...	...	...	...	...	...	
—— Grahamianus	...	1	...	...	...	...	...	...	...	
—— callosus	...	1	...	...	...	...	...	...	...	
—— Zeylanicus	1	...	...	...	...	...	...	...	...	
—— Walkeri	1	...	...	...	...	...	...	...	...	
—— Thwaitesii	1	...	...	...	...	...	...	...	...	
—— deflexus	1	...	...	...	...	...	...	...	...	
—— tristis	...	1	...	...	...	...	...	...	...	
—— caudatus	1	...	...	...	...	...	...	...	...	
—— pallidus	...	1	...	...	...	...	...	...	...	
—— decurrens	...	...	...	...	...	...	1	...	...	
—— fimbriatus	...	...	...	...	...	...	1	...	...	
—— polythrix	...	...	...	...	...	...	1	...	...	
—— remotus	...	...	...	...	...	...	...	1	...	
—— Khasyanus	...	...	...	...	...	...	1	...	...	

Table (*continued*).

	Ceylon.	Western Peninsula.	Central India.	Lower Gangetic Plain.	Northern Hindostan.	Himalaya.	Eastern Bengal.	Burmah.	Malayan Peninsula.	Distribution out of India.
Strobilanthes haplanthoides	...	...	...	...	...	...	...	1	...	
—— perfoliatus	...	1	...	...	...	...	...	...	...	
—— Helferi	...	...	...	...	...	...	...	1	...	
—— auriculatus	...	...	1	...	...	1	1	1	...	
—— Sabinianus	...	...	...	...	...	1	1	...	...	
—— rufescens	...	...	...	...	...	...	...	1	...	
—— Brunonianus	...	...	...	...	...	...	1	...	...	
—— maculatus	...	...	...	...	...	1	1	...	...	
—— imbricatus	...	...	...	...	...	...	...	1	...	
—— acrocephalus	...	...	...	...	...	...	1	...	...	
—— acuminatus	...	...	...	...	...	...	...	1	...	
—— pectinatus	...	...	...	...	...	1	1	...	...	
—— Simonsii	...	...	...	...	...	...	1	...	...	
—— glabratus	...	...	...	...	...	...	1	...	...	
—— gracilis	...	...	...	...	...	...	1	...	...	
—— nutans	...	...	..	...	...	1	...	...	...	
—— glomeratus	...	...	...	...	...	...	1	1	...	
—— capitatus	...	...	...	...	...	1	1	1	...	
—— Brandisii	...	...	...	...	...	...	...	1	...	
—— biceps	...	...	...	...	...	...	...	1	...	
—— lamiifolius	...	...	...	...	...	1	1	...	...	
—— collinus	...	...	...	...	...	...	...	...	1	
—— glutinosus	...	...	...	...	...	1	...	...	...	
—— alatus	...	...	...	...	...	1	...	...	...	
—— extensus	...	...	...	...	...	...	1	...	...	
—— inflatus	...	...	...	...	...	1	...	...	...	
—— atropurpureus	...	...	...	...	...	1	...	...	...	
—— Wallichii	...	...	...	...	...	1	...	...	...	
—— urophyllus	...	...	...	...	...	1	1	...	...	
—— pentstemonoides	...	...	...	...	...	1	...	...	...	
—— cratægifolius	...	...	...	...	...	...	...	1	...	
—— discolor	...	...	...	...	...	1	...	...	...	
—— isophyllus	...	...	...	...	...	...	1	...	...	
—— anisophyllus	...	...	...	...	...	...	1	...	...	
—— Thomsoni	...	...	...	...	...	1	...	...	...	
—— divaricatus	...	...	...	...	...	1	1	...	...	
—— Panichanga	...	...	...	...	...	...	1	...	...	
—— Boërhaavioides	...	...	...	...	...	...	1	...	...	
—— rubescens	...	...	...	...	...	...	1	...	...	
—— helictus	...	...	...	...	...	1	1	...	...	
—— secundus	...	...	...	...	...	...	1	...	...	
—— lancifolius	...	...	...	...	...	...	...	1	...	
—— flaccidifolius	...	...	...	...	...	...	1	1	...	China.
—— Griffithianus	...	...	...	...	...	...	1	...	...	
—— coloratus	...	...	...	...	...	...	1	...	...	
—— crinitus	...	...	...	...	...	...	1	...	...	
—— Mastersi	...	...	...	...	...	...	1	...	...	

Table (*continued*).

	Ceylon.	Western Peninsula.	Central India.	Lower Gangetic Plain.	Northern Hindostan.	Himalaya.	Eastern Bengal.	Burmah.	Malayan Peninsula.	Distribution out of India.
Strobilanthes microcarpus	...	...	...	...	...	...	...	1	...	
—— Beddomei	...	1	...	...	...	...	...	...	...	
—— sexennis	1	...	...	...	...	...	...	...	...	
—— helicioides	1	...	...	...	...	...	...	...	...	
—— rubicundus	...	1	...	...	...	...	...	...	...	
—— pulcherrimus	1	1	...	...	...	...	...	...	...	
—— paniculatus	1	1	...	...	...	...	...	...	...	
—— denticulatus	...	...	...	...	...	...	1	...	...	
—— spicatus	...	...	...	...	...	...	1	...	...	
—— salicifolius	...	...	...	...	...	...	...	...	...	
—— Falconeri	...	...	...	...	...	...	...	1	...	
—— lamioides	...	...	...	...	...	...	...	1	...	
—— violæfolius	...	...	...	...	...	1	...	...	...	
Æchmanthera Wallichii	...	...	...	...	...	1	1	...	...	
Dædalacanthus tubiflorus	..	...	...	...	...	...	1	...	...	
—— splendens	...	...	...	...	...	1	...	...	...	
—— Griffithii	...	...	...	...	...	...	1	...	...	
—— nervosus	...	...	...	...	...	1	1	...	...	
—— scaber	...	...	...	...	...	1	1	...	...	
—— macrophyllus	...	...	...	...	...	...	...	1	...	
—— strictus	...	...	...	...	...	...	1	...	...	
—— roseus	...	1	...	...	...	...	...	...	...	
—— tetragonus	...	...	...	...	...	...	...	1	...	
—— suffruticosus	...	...	...	...	...	...	...	1	...	
—— microstachyus	...	...	...	...	...	...	...	1	...	
—— purpurascens	...	1	1	...	...	...	...	...	...	
—— montanus	1	1	...	...	...	...	...	1	...	
—— Parishii	...	...	...	...	...	...	...	1	...	
Barleria buxifolia	...	1	...	...	...	...	...	...	...	
—— spina zeylanica	1	1	...	...	...	...	...	...	...	
—— acanthoides	...	...	...	...	1	...	...	...	...	Arabia, Abyssinia.
—— noctiflora	...	1	...	...	1	...	...	...	...	
—— cuspidata	...	1	...	...	...	...	...	...	...	
—— Prionitis	1	1	...	1	1	...	1	...	...	Java, Abyssinia.
—— cristata	1	1	1	1	1	1	1	1	1	Java, Hongkong.
—— tomentosa	...	1	...	...	...	...	...	...	...	
—— longiflora	...	1	...	...	...	...	...	...	...	
—— pilosa	...	1	...	...	...	...	...	...	...	
—— nitida	...	1	...	...	...	...	...	...	...	
—— polytricha	...	...	...	..	...	...	...	1	...	
—— cærulea	...	1	1	...	...	1	1	...	...	
—— Lawii	...	1	...	...	...	...	...	...	..	
—— involucrata	1	1	...	...	...	...	...	...	...	
—— Arnottiana	1	...	...	...	...	...	...	...	...	
—— vestita	1	...	...	...	...	...	...	...	...	
—— montana	...	1	1	...	...	...	...	...	...	
—— Gibsoni	...	1	...	...	...	...	...	...	...	

Table (*continued*).

	Ceylon.	Western Peninsula.	Central India.	Lower Gangetic Plain.	Northern Hindostan.	Himalaya.	Eastern Bengal.	Burmah.	Malayan Peninsula.	Distribution out of India.
Barleria grandiflora	...	1	...	...	...	...	...	...	...	
—— Stocksii	...	1	...	...	...	...	...	...	...	
—— nutans	1	...	...	...	...	...	...	...	...	
—— Courtallica	...	1	...	...	...	...	...	...	...	
—— conspicua	...	...	...	...	...	...	...	...	1	
—— Hochstetteri.........	...	...	...	...	1	...	...	...	...	Abyssinia.
Neuracanthus tetragonostachyus..................	...	...	...	...	...	...	...	1	...	
—— trinervius	...	1	...	...	...	...	...	...	...	
—— Lawii	...	1	...	...	...	...	...	...	...	
Crossandra infundibuliformis	1	1	...	1	...	1	...	...	1	
Lepidagathis cristata ...	...	1	1	...	1	...	...	...	...	
—— rupestris	...	1	...	...	...	...	...	...	...	
—— Shuteri	...	1	...	...	...	...	...	...	...	
—— trinervis	...	1	1	1	...	1	...	...	...	
—— lutea	...	1	...	...	...	...	...	...	...	
—— spinosa	...	1	...	...	...	...	...	...	...	
—— pungens	...	1	...	...	...	...	...	...	...	
—— clavata	...	1	...	...	...	...	...	...	...	
—— rigida	...	1	...	...	1	...	...	...	...	
—— prostrata	...	1	...	...	...	...	...	...	...	
—— cuspidata	...	1	...	...	...	1	...	...	...	
—— calycina	...	...	...	...	1	...	...	...	...	Abyssinia.
—— falcata	...	...	...	...	...	...	...	1	...	
—— chlorostachya	...	...	...	...	...	...	...	1	...	
—— purpuricaulis	...	...	1	...	...	1	...	1	...	
—— dulcis	...	...	...	...	...	...	...	1	...	
—— iridescens	...	...	...	...	...	...	...	1	...	
—— linearis	...	...	...	...	...	...	...	1	...	
—— scariosa	...	1	...	...	...	...	...	...	...	
—— neurophylla	...	1	...	...	...	...	...	...	...	
—— simplex	...	...	...	...	...	...	...	1	...	
—— hyalina	...	1	1	1	1	1	1	1	...	Malay Islands, China.
—— Zeylanica	1	...	...	...	...	...	...	...	...	
—— fasciculata...........	1	1	1	...	...	...	...	1	...	
—— Walkeriana	1	...	...	...	...	...	...	...	...	
—— Neesiana	...	1	...	...	...	...	...	...	...	
—— Beddomei	...	...	1	...	...	...	...	...	...	
—— longifolia	...	...	...	...	...	...	...	...	1	
Blepharis Boërhaaviæfolia	1	1	1	...	1	...	...	1	...	Abyssinia, Senegambia, Guinea.
—— molluginifolia	1	1	1	...	1	...	...	...	...	
—— asperrima...........	...	1	...	...	...	...	...	...	...	
—— Sindica	...	...	...	...	1	...	...	...	...	
—— edulis	...	...	...	...	1	...	...	...	...	Persia, Arabia, Egypt.

Table (*continued*).

	Ceylon.	Western Peninsula.	Central India.	Lower Gangetic Plain.	Northern Hindostan.	Himalaya.	Eastern Bengal.	Burmah.	Malayan Peninsula.	Distribution out of India.
Acanthus carduaceus ...	...	...	...	...	...	1	...	...	...	
—— leucostachyus	...	...	...	...	...	...	1	...	...	
—— ilicifolius	1	1	...	1	...	...	1	1	1	Nubia, Java, China.
—— volubilis	...	...	...	1	...	...	...	1	1	Java, Moluccas.
Andrographis Neesiana...	...	1	...	...	...	...	...	...	...	
—— lineata	...	1	...	...	...	...	...	...	...	
—— viscosula	...	1	...	...	...	...	...	...	...	
—— affinis	...	1	...	...	...	...	...	...	...	
—— paniculata...	1	1	1	1	1	1	1	...	...	Java.
—— alata	1	1	...	...	...	...	...	...	...	
—— elongata	...	1	...	...	...	...	...	...	...	
—— tenuiflora	...	...	...	...	...	...	...	1	...	
—— Zeylanica	1	...	...	...	...	...	...	...	...	
—— Wightiana	1	1	...	...	...	...	...	...	...	
—— gracilis	...	1	...	...	...	...	...	...	...	
—— echioides	1	1	1	...	1	...	...	1	...	
—— serpyllifolia	...	1	...	...	...	...	...	...	...	
—— lobelioides	...	1	...	...	...	...	...	...	...	
Haplanthus hygrophiloides	...	...	...	...	...	...	...	1	...	
—— tentaculatus	...	1	1	...	...	...	...	...	...	
—— plumosus	...	1	...	...	...	...	...	...	...	
—— verticillaris	...	1	1	...	...	...	...	...	...	
Gymnostachyum Parishii	...	...	...	...	...	...	...	1	...	
—— andrographioides...	...	...	...	...	...	...	1	1	...	
—— hirsutum	1	...	...	...	...	...	...	...	...	
—— paniculatum	1	...	...	...	...	...	...	...	...	
—— canescens	...	1	...	...	...	...	...	...	...	
—— serrulatum	...	1	...	...	...	...	...	...	...	
—— tomentosum	...	...	1	...	...	...	...	...	...	
—— latifolium	...	1	...	...	...	...	...	...	...	
—— sanguinolentum ...	1	...	...	...	...	...	...	...	...	
—— glabrum	...	1	...	...	...	...	...	...	...	
—— venustum	...	...	...	...	...	...	1	...	...	
—— Zeylanicum	...	1	...	...	...	...	...	...	...	
—— alatum	...	1	...	...	...	...	...	...	...	
Phlogacanthus thyrsiflorus	...	...	...	...	...	1	1	1	...	
—— curviflorus	...	...	...	...	...	...	1	...	...	
—— tubiflorus	...	...	...	...	...	...	1	...	...	
—— parviflorus	...	...	...	...	...	...	1	...	...	
—— guttatus	...	...	...	...	...	1	1	...	...	
—— vitellinus...	...	...	...	...	...	1	1	...	...	
—— pulcherrimus	...	...	...	...	...	...	...	1	...	
—— elongatus	...	...	...	...	...	...	...	1	...	
—— latifolius	...	1	...	...	...	...	...	...	...	
—— pubinervis	...	...	...	...	...	1	1	...	...	

Table (*continued*).

	Ceylon.	Western Peninsula.	Central India.	Lower Gangetic Plain.	Northern Hindostan.	Himalaya.	Eastern Bengal.	Burmah.	Malayan Peninsula.	Distribution out of India.
Justicia montana	...	1	...	...	...	...	...	...	...	
—— Adhatoda	1	1	1	1	1	1	1	...	...	Java, China.
—— ventricosa	...	...	...	...	...	...	...	1	...	
—— Atkinsoni	...	...	...	...	...	1	...	...	...	
—— argyrostachya	...	...	...	...	...	...	...	1	...	
—— grandifolia	...	...	...	...	...	...	...	1	...	
—— Betonica	1	1	1	...	...	...	...	...	...	Abyssinia, South Africa, Java.
—— ramosissima	...	1	...	...	...	...	...	...	...	
—— Orixensis	...	1	...	...	...	...	...	...	...	
—— peploides	...	1	1	1	1	1	1	...	...	Affghanistan.
—— procumbens	1	1	1	1	1	1	1	1	1	Java, New Holland.
—— orbiculata	...	1	1	1	1	...	...	...	...	Abyssinia, Java.
—— diffusa	1	1	1	...	...	...	...	1	...	
—— gracilis	...	1	...	...	...	...	...	...	...	
—— heterocarpa	...	...	...	...	1	...	...	...	...	Abyssinia.
—— Gendarussa	...	1	...	1	...	...	1	1	...	Malay Islands, China.
—— Hookeriana	1	...	...	...	...	...	...	...	...	
—— Zeylanica	1	...	..	...	...	...	...	...	...	
—— Tranquebariensis...	1	1	...	...	...	...	...	...	...	
—— Neesiana	...	...	...	...	...	...	1	...	...	
—— salicifolia	...	...	...	...	...	...	1	...	...	
—— quadrifaria	...	...	...	...	...	...	1	1	...	Java.
—— Brandisii	...	...	...	...	...	...	...	1	...	
—— salsoloides	...	1	...	...	...	...	...	...	...	
—— decussata	...	...	...	...	...	...	...	1	...	Sumatra.
—— Wynaadensis	...	1	...	...	...	...	...	...	...	
—— vasculosa	...	...	...	...	...	...	1	1	...	
—— collina	...	...	...	...	...	1	...	...	...	
—— dichotoma...........	1	...	...	...	...	...	...	...	...	
—— glabra	...	1	...	...	...	...	...	...	...	Abyssinia.
—— Edgeworthii	...	...	...	...	...	1	...	...	...	
—— virgata	...	...	...	...	...	...	1	1	...	
—— Wallichii	...	1	...	...	...	...	...	...	...	
—— Griffithii	...	...	...	...	...	...	1	...	...	
—— Boerhaaviæfolia ...	...	...	...	...	...	...	...	1	...	
—— Ptychostoma	...	...	...	...	...	...	...	...	1	
Ptyssiglottis radicosa ...	1	...	...	...	...	...	...	...	...	
Monothecium aristatum .	1	1	...	...	...	...	...	...	...	
Rungia linifolia............	...	1	...	...	...	...	...	...	...	
—— longifolia	1	...	...	...	...	...	...	...	...	
—— pectinata	1	1	1	1	1	1	...	1	...	Java.
—— repens	1	1	1	1	1	1	...	...	...	Java.
—— latior................	1	1	...	...	...	...	...	...	...	
—— Wightiana	...	1	...	...	...	...	...	...	...	
—— crenata	...	1	...	...	...	...	...	...	...	

Table (*continued*).

	Ceylon.	Western Peninsula.	Central India.	Lower Gangetic Plain.	Northern Hindostan.	Himalaya.	Eastern Bengal.	Burmah.	Malayan Peninsula.	Distribution out of India.
Rungia Sisparensis	...	1	...	...	...	...	...	...	...	
—— Punduana	...	...	...	...	...	...	1	...	...	
—— Khasyana	...	...	...	...	...	...	1	...	...	
—— Mastersi	...	...	...	...	...	...	1	...	...	
Dicliptera bivalvis	1	1	...	...	...	...	...	...	...	
—— Roxburghii	...	1	1	1	1	1	1	...	...	
—— riparia	...	...	...	...	...	...	...	1	...	
—— cuneata	...	1	...	...	...	...	...	...	...	
—— micranthes	...	...	1	...	1	...	...	...	...	Abyssinia.
Peristrophe bicalyculata	...	1	1	...	1	...	...	1	...	Arabia, Abyssinia, Africa, Cape de Verde.
—— speciosa	...	...	...	...	...	1	1	...	...	
—— tinctoria	1	...	...	1	...	...	1	...	...	Java, Moluccas.
—— montana	...	1	...	...	...	...	1	..	...	
—— acuminata	...	...	...	...	...	...	1	1	1	
—— fragilis	...	...	...	...	...	...	...	1	...	
—— lanceolaria	...	...	...	...	...	...	1	1	...	
Hypoestes lanata	...	1	...	...	...	...	...	...	...	
—— Malaccensis	...	...	...	...	...	...	...	...	1	
—— triflora	...	...	...	...	...	1	...	...	...	
Rhinacanthus communis	1	1	1	...	...	...	...	1	...	Java, Madagascar.
—— calcaratus	...	...	...	...	...	...	1	...	...	
Graptophyllum hortense (cultivated).										
Eranthemum Ebolium	1	1	1	1	...	...	1	...	1	Arabia, Abyssinia, Madagascar.
—— crenulatum	1	1	...	...	...	...	...	1	1	Java.
—— Blumei	...	...	...	...	...	...	...	...	1	Sumatra.
—— album	...	...	...	...	...	...	...	1	...	
—— palatiferum	...	...	...	...	...	...	1	...	...	
—— cinnabarinum	...	...	...	...	...	...	...	1	...	
Codonacanthus pauciflorus	...	...	...	...	...	...	1	...	...	Hongkong.
Asystasia Mysorensis	...	1	1	...	...	...	...	...	...	
—— lanceolata	...	...	...	...	...	...	...	1	...	
—— nemorum	1	1	...	...	...	...	...	...	...	Java.
—— chelonoides	1	1	...	...	...	...	...	...	...	
—— Gangetica	1	1	1	1	...	...	...	...	1	Eastern Africa, Western Africa, Cape of Good Hope, Madagascar.
—— macrocarpa	...	...	...	...	...	1	...	...	...	
—— Thyrsacanthus	...	...	...	...	...	1	1	...	...	
—— Kunthiana	...	...	...	...	...	...	...	...	1	

Table (*continued*).

	Ceylon.	Western Peninsula.	Central India.	Lower Gangetic Plain.	Northern Hindostan.	Himalaya.	Eastern Bengal.	Burmah.	Malayan Peninsula.	Distribution out of India.
Asystasia Neesiana	...	...	...	...	...	...	1	...	...	
—— Parishii	...	...	...	...	...	...	...	1	...	
—— atroviridis	...	...	...	...	...	...	1	...	...	
—— crispata.............	...	1	...	...	...	...	...	...	...	

From this table it will be seen that by far the largest number of species are confined to certain regions of India, while those having an extensive geographical range in India occur also in other countries of Asia, and some even extend to Africa and America.

Fifty-two species found in India have been discovered beyond the geographical limits of this enumeration. Their distribution is as follows:—

	Species.
Malayan islands, Philippines, China.........	33
Tropical Australia	4
Affghanistan, Persia, Arabia	7
Tropical Africa and Madagascar	21
Tropical America	2
Islands of the Pacific Ocean	1

Of these fifty-two species, thirty-eight are found in Central India, the Lower Gangetic plain, and Northern Hindostan, the provinces in which Acanthaceæ are comparatively rare. The remaining fourteen species, none of which occur in these three provinces, with one exception, inhabit, out of India, the Malayan and Philippine islands; and in India eight of them are confined to Burmah or to the Malayan peninsula.

A few species of Acanthaceæ extend into Northern Hindostan from the adjoining arid countries to the west of the Indus; these are *Barleria acanthoides*, *noctiflora* and *Hochstetteri*, *Lepidagathis calycina* (Abyssinian). *Blepharis edulis*, *Justicia heterocarpa*, and *Dicliptera micranthes*. Two true desert forms, *Ruellia longifolia* and *Blepharis Sindica*, are confined to Scinde.

The largest number of species of Acanthaceæ is found in the

western peninsula, where the total number of species is 167. Of these more than half are peculiar to the province—an additional proof that it is in this province of India that Acanthaceæ acquire their greatest development. Burmah ranks next, the total number of species in it being 102, and those that are peculiar 62, or more than half the entire aumber. In Eastern Bengal, Ceylon, and the Himalaya, placed in this sequence according to the number of species of Acanthaceæ found in them, the proportion that the peculiar species bear to the total number is much less than in the western peninsula and Burmah. The provinces of Central India, Northern Hindostan, and the Lower Gangetic plain, where cultivation, carried on for many ages, has left hardly any tracts covered with forests, do not favour the existence of Acanthaceæ. Accordingly in Central India, which of these three provinces possesses the largest number of Acanthaceæ, only 46 species are found, of which three are peculiar. If we exclude from the species found in Northern Hindostan the seven species already mentioned as extending into that region from the countries to the west of the Indus, only thirty species remain, all of which have a wide geographical range in India, and in many cases are found in other parts of the tropics. Thirty-three species occur in the Lower Gangetic plain; and only one of them, *Calophanes Nagchana*, is peculiar to the region. Twenty-seven species have been discovered in the Malayan peninsula, and 14 are peculiar; but both these numbers will probably be much increased, and the proportion of peculiar species altered, when the mountains of this province have been fully explored. These results are given in a tabular form on pages 440 and 441. In each of the divisions of this table the first column shows the number of species of each genus which are peculiar to a province, and the second column the total number of species of the genus in the same district. In this manner the table indicates the distribution of the genera in the nine provinces of India.

Some of the regions of India are marked by the prevalence of certain genera of Acanthaceæ, and frequently by the abundance of species of allied genera, which I have classed as tribes or subtribes. For example, the subtribe Strobilantheæ is represented in Eastern Bengal by 40 species, or very nearly half the number of Acanthaceæ found in the district, while more than half the peculiar species are members of this subtribe. In Ceylon, the

Western Peninsula, the Himalaya, Eastern Bengal, and Burmah the largest number of Acanthaceæ belong to this subtribe, which may thus be considered the representative of the order in India. The entire absence of *Strobilanthes* from Northern Hindostan and the Lower Gangetic Plain, and the occurrence of only two species in Central India, are facts in the geographical distribution of the order worthy of notice. The abundance of the tribes Barlerieæ and Andrographideæ, as well as of Strobilantheæ, in the Western Peninsula, and the large proportion of peculiar species of these groups, show that the order acquires its greatest development in that province.

The genus *Ebermaiera* is almost confined to Burmah, the Malayan Peninsula, and the Khasia Hills, the obscure weed *E. glauca* and the nearly allied *E. Zeylanica* being the sole representatives of this genus in the other regions of India. The species of *Ebermaiera* are most numerous in Burmah, where twelve have been found, only three of which extend beyond the limits of the province.

In India Acanthaceæ are preeminently inhabitants of the tropical and subtropical forests of the hilly districts, and are seldom found at greater elevations on the mountains. The only one that reaches alpine altitudes is *Strobilanthes Wallichii*, which in Sikkim rarely occurs below 7500 feet, and is frequent at heights ranging from 8000 to 10,000 feet. I moreover collected many examples of this species in the lofty valley of the Ratong, as the head of the Great Rungeet River is called, between Jongri and Aloktong, below the glaciers of Kanchinjunga, where the plants grow among thickets of *Rhododendron* and *Lonicera*. A remarkable and very local species of *Thunbergia* (*T. lutea*, T. Anders.), *Strobilanthes pectinatus*, *urophyllus*, and *divaricatus* are common in Sikkim from 5000 to 8000 feet; and in the north-western Himalaya, even so far west as Simlah and Kangra, *Strobilanthes alatus* occurs from 5000 to 7000 feet above the sea, in moist woods of oak, *Abies Smithiana*, and *Pinus excelsa*. The only maritime forms in India are *Acanthus ilicifolius* and *A. volubilis*: the first of these is not confined to estuaries communicating with the sea; it is common near Calcutta along the banks of canals the waters of which, though they are influenced by the tides, never intermingle with the waters of the sea.

TABLE II.—Distribution of

Genus.	Ceylon.		Western Peninsula.		Central India.		Lower Gangetic Plain.		Northern
	Species peculiar to region.	Total number of species.	Species peculiar to region.	Total number of species.	Species peculiar to region.	Total number of species.	Species peculiar to region.	Total number of species.	Species peculiar to region.
Thunbergia	...	2	3	6	...	1	...	1	...
Elytraria	...	1	...	1	...	1	...	1	...
Nelsonia	...	1	...	1	...	1	...	1	...
Ebermaiera	...	2	...	2	...	1	...	1	...
Adenosma	1	4	2	5	...	...	...	3	...
Nomaphila	...	...	...	...	...	...	...	...	...
Hygrophila	...	2	...	4	...	4	...	3	...
Cystacanthus	...	...	...	...	...	...	...	...	...
Echinacanthus	...	...	...	...	...	...	...	...	...
Calophanes	...	2	1	3	...	1	1	1	...
Ruellia	...	3	...	2	1	2	...	2	1
Petalidium	...	...	...	1	...	1	...	...	...
Phaylopsis	...	1	...	1	...	...	...	1	...
Hemigraphis	...	...	2	3	...	1	...	1	...
Stenosiphonium	1	2	3	4	...	...	...	...	...
Strobilanthes	16	23	25	31	...	1	...	...	...
Æchmanthera	...	...	...	...	...	...	...	...	...
Dædalacanthus	...	1	1	3	...	1	...	...	...
Barleria	3	7	11	18	...	3	...	2	2
Neuracanthus	...	...	2	2	...	...	...	...	...
Crossandra	...	1	...	1	...	...	...	...	...
Lepidagathis	2	3	10	16	1	6	...	2	1
Blepharis	...	2	1	3	...	2	...	...	2
Acanthus	...	1	...	1	...	...	...	2	...
Andrographis	1	5	8	12	...	2	...	1	...
Haplanthus	...	...	1	3	...	2	...	...	...
Gymnostachyum	4	4	5	5	1	1	...	...	...
Phlogacanthus	...	...	1	1	...	...	...	...	...
Justicia	3	8	8	16	...	6	...	5	1
Ptyssiglottis	1	1	...	...	...	...	...	...	...
Monotheeium	...	1	...	1	...	...	...	...	...
Rungia	1	4	4	7	...	2	...	2	...
Dicliptera	...	1	1	3	...	2	...	1	...
Peristrophe	...	1	...	2	...	1	...	1	...
Hypoestes	...	...	1	1	...	...	...	...	...
Rhinacanthus	...	1	...	1	...	1	...	...	...
Graptophyllum (cultivated).									
Eranthemum	...	2	...	2	...	1	...	1	...
Codonacanthus	...	...	...	...	...	...	...	...	...
Asystasia	...	3	1	5	...	2	...	1	...

Genera of Acanthaceæ.

India.	Himalaya.		Eastern Bengal.		Burmah.		Malayan Peninsula.		Genus.
Total number of species.	Species peculiar to region.	Total number of species.	Species peculiar to region.	Total number of species.	Species peculiar to region.	Total number of species.	Species peculiar to region.	Total number of species.	
1	1	4	...	2	1	2	...	...	Thunbergia.
1	...	...	...	...	...	...	...	...	Elytraria.
1	...	1	...	1	...	1	...	...	Nelsonia.
1	...	...	2	5	9	12	6	7	Ebermaiera.
1	...	1	...	3	1	1	...	1	Adenosma.
...	...	...	...	...	1	1	...	...	Nomaphila.
3	...	2	...	3	...	3	...	2	Hygrophila.
...	...	...	...	...	2	2	...	...	Cystacanthus.
...	1	1	1	2	...	...	...	...	Echinacanthus.
...	...	...	...	...	...	...	...	...	Calophanes.
3	...	...	...	...	1	3	...	1	Ruellia.
...	...	1	...	...	...	...	...	...	Petalidium.
...	...	...	...	1	...	1	...	...	Phaylopsis.
1	...	2	...	...	2	3	1	1	Hemigraphis.
...	...	...	...	...	...	...	...	...	Stenosiphonium.
...	10	19	22	34	16	21	1	1	Strobilanthes.
...	...	1	...	1	...	...	...	...	Æchmanthera.
...	1	3	3	5	5	6	...	...	Dædalacanthus.
5	...	2	...	3	1	2	1	2	Barleria.
...	...	...	...	...	1	1	...	...	Neuracanthus.
...	...	1	...	...	...	...	...	...	Crossandra.
4	...	4	...	1	6	9	1	1	Lepidagathis.
4	...	...	...	...	...	1	...	...	Blepharis.
...	1	1	1	1	...	2	...	2	Acanthus.
2	...	1	...	1	1	2	...	...	Andrographis.
...	...	...	...	...	...	...	...	...	Haplanthus.
...	...	...	1	2	1	2	...	...	Gymnostachyum.
...	...	4	3	7	2	3	...	...	Phlogacanthus.
5	3	6	3	10	6	12	1	2	Justicia.
...	...	...	...	...	...	...	...	...	Ptyssiglottis.
...	...	...	...	...	...	...	...	...	Monothecium.
2	...	2	3	3	...	1	...	...	Rungia.
2	...	1	...	1	1	1	...	...	Dicliptera.
1	...	1	...	5	1	4	...	1	Peristrophe.
...	1	1	...	...	...	...	1	1	Hypoestes.
...	...	...	1	1	...	1	...	...	Rhinacanthus.
									Graptophyllum (cultivated).
...	...	...	1	2	2	3	1	3	Eranthemum.
...	...	...	1	1	...	...	...	...	Codonacanthus.
...	1	2	2	3	2	2	1	2	Asystasia.

CONSPECTUS GENERUM.

Subordo I. THUNBERGIDEÆ.

Calyx ad annulum carnosum, integrum vel pluridentatum reductus. Corollæ lobi æstivatione contorti. Semina cupula suffulta.—Plantæ volubiles, raro prostratæ.

1. THUNBERGIA. *Calyx* inconspicuus, bracteis duabus magnis occultus.

Subordo II. RUELLIDEÆ.

Calyx herbaceus, 5-, raro 4-partitus. Corollæ lobi æstivatione contorti. Semina retinaculo uncinato (vel papilla) suffulta.—Plantæ non volubiles.

Tribus I. NELSONIEÆ.

Calyx parvus, herbaceus. Semina minuta, globosa, papilla parva suffulta.—Herbæ neglectæ.

† *Corolla infundibuliformis.*

2. ELYTRARIA. *Stamina* antherifera 2; sterilia 2.—*Herbæ* acaules. *Scapi* folia squamæformia, adpressa.
3. NELSONIA. *Stamina* 2, sterilia nulla.—*Herbæ* caulescentes.
4. EBERMAIERA. *Stamina* 4, didynama, antherifera.

†† *Corolla bilabiata.*

5. ADENOSMA. *Stamina* 4, rarissime 2.

Tribus II. RUELLIEÆ.

Calyx parvus, herbaceus. Semina conspicua, compressa, retinaculo uncinato suffulta.

Subtribus I. HYGROPHILEÆ.

Corolla bilabiata. Capsula polysperma, valvis striatis vel sulcatis.

6. NOMAPHILA. *Capsula* linearis, compressa. *Flores* laxe paniculati.
7. HYGROPHILA. *Capsula* teretiuscula vel oblonga. *Flores* verticillati, sessiles.

Subtribus II. EURUELLIEÆ.

Corolla infundibuliformis. Capsula basi sterilis, supra medium seminifera.

† *Bracteæ minutæ vel nullæ.*

* *Capsula compressa, sublinearis.*

8. CYSTACANTHUS. *Corolla* paullo curvata, ore constricto. *Stamina* inclusa 2, cum rudimentis 2 sterilium ; antheris muticis. *Stigma* bifidum. *Capsula* sublinearis, 12-sperma.

9. ECHINACANTHUS. *Corolla* infundibuliformis. *Stamina* 4, inclusa, antheris unicalcaratis. *Stigma* simplex. *Capsula* polysperma.

** *Capsula subteres.*

10. CALOPHANES. *Corolla* recta. *Antheræ* basi bicalcaratæ. *Capsula* acuta, apice 4-sperma.

11. RUELLIA. *Corolla* recta vel curvata. *Antheræ* muticæ. *Capsula* apice tumida, subglobosa, polysperma.

†† *Bracteæ* 2, *magnæ, corollam tegentes. Capsula obovata, basi breviter constricta, a dorso compressa.*

12. PETALIDIUM. *Bracteæ* membranaceæ. *Calyx* 5-partitus. *Corolla* in æstivatione bracteis 2 magnis occulta. *Flores* solitarii.

††† *Bractea* 1, *magna ; bracteolæ* 2, *breviores.*

13. PHAYLOPSIS. *Calyx* inæqualiter 5-partitus. *Flores* dense spicati.

Subtribus III. STROBILANTHEÆ.

Calyx inæqualiter partitus. Corolla infundibuliformis, plerumque curvata, lobis æqualibus. Stamina 4. *Stigma subulatum. Capsula basi sterilis,* 4–16-*sperma.*

14. HEMIGRAPHIS. *Bracteæ* magnæ, imbricatæ, calycem tegentes. *Corolla* recta, intus tomentosa. *Stamina* inclusa. *Capsula* 6–16-sperma.

15. STENOSIPHONIUM. *Bracteæ* calyce minores. *Corolla* curvata, intus ad faucem punctis 2 hirsutis notata. *Stamina* exserta. *Capsula* 8-sperma.

16. STROBILANTHES. *Corolla* recta vel curvata, intus lineis 2

longitudinalibus barbatis notata. *Antheræ* muticæ. *Capsula* 4-sperma.

17. ÆCHMANTHERA. *Corolla* fere recta. *Flores* paniculati. *Antheræ* apice mucronatæ. *Capsula* 8–12-sperma.

18. DÆDALACANTHUS. *Bracteæ* magnæ, variegatæ. *Calyx* scariosus. *Corolla* limbo hypocraterimorpho vel infundibuliformi. *Antheræ* muticæ. *Capsula* oblonga, 4-sperma.

Subordo III. ACANTHIDEÆ.

Calyx herbaceus, 5-, raro 4-partitus. Corollæ lobi æstivatione imbricati vel imbricato-bilabiati. Semina retinaculo uncinato suffulta.

Tribus I. BARLERIEÆ.

Corolla hypocraterimorpha vel infundibuliformis, lobis in æstivatione imbricatis (in Lepidagathide *bilabiatis).*

Sect. 1. *Corollæ lobi æstivatione imbricati.*

† *Antheræ biloculares.*

19. BARLERIA. *Calyx* 4-partitus. *Corolla* regulariter infundibuliformis vel hypocraterimorpha. *Stamina* 2 vel 4 antherifera, cum 3 (vel 1) sterilibus brevioribus.

20. NEURACANTHUS. *Calyx* inæqualiter 5-partitus. *Corolla* infundibuliformis, lobis in æstivatione plicato-imbricatis. *Stamina* 4, didynama, antherifera.

†† *Antheræ uniloculares.*

21. CROSSANDRA. *Calyx* 5-partitus. *Corolla* hypocraterimorpha. *Stamina* 4, didynama.

Sect. 2. *Corollæ lobi æstivatione bilabiati.*

22. LEPIDAGATHIS. *Calyx* 5-partitus. *Corolla* bilabiata. *Stamina* 4, didynama; *antheris* bilocularibus.

Tribus II. ACANTHEÆ.

Corolla unilabiata; lobis 3 vel 5, medio in æstivatione exteriore. Stamina 4, antheris unilocularibus.

23. BLEPHARIS. *Calyx* lacinia superiore integra 3-nervi, inferiore 2-nervi. *Capsula* valvis membranaceis.

24. ACANTHUS. *Corolla* tubo brevissimo. *Calyx* lacinia superiore 4- vel plurinervi. *Capsula* valvis chartaceis.

Tribus III. ANDROGRAPHIDEÆ.

Corolla limbo bilabiato. Stamina 2; antheris bilocularibus, plus minus barbato-ciliatis; filamentis ligulatis, alatis. Capsula polysperma.

25. ANDROGRAPHIS. *Corolla* resupinata, limbo constricto. *Stamina* per antheras barbatas cohærentia. *Capsula* valde compressa. *Racemi* secundiflori.

26. HAPLANTHUS. *Corolla* subinfundibuliformis. *Stamina* cohærentia. *Capsula* depressa 8–20-sperma. *Rami* axillares difformes, verticillato-fasciculati, apice spiniformes.

27. GYMNOSTACHYUM. *Corolla* infundibuliformis, tubo curvato. *Stamina* libera; filamentis sæpe dilatatis, ciliatis. *Capsula* tetragona. *Inflorescentia* subsecunda.

Tribus IV. PHLOGACANTHEÆ.

Corolla tubulosa, limbo bilabiato. Stamina 2, antheris bilocularibus, loculis parallelis muticis. Capsula subteres, polysperma. Inflorescentia terminalis, spiciformis.

28. PHLOGACANTHUS. *Corolla* firma, tubo plus minus incurvo.

Tribus V. JUSTICIEÆ.

Corolla bilabiata. Stamina fertilia 2, loculis plus minus superpositis. Capsula basi sterilis contracta, apice seminifera tetrasperma tumida.

Subtribus I. EUJUSTICIEÆ.

Corolla tubo non elongato, recto; labio inferiore trifido, lobo medio lateralibus majore; labio superiore brevissime bidentato. Stamina 2.

† *Capsula dehiscens, simpliciter bivalvis.*

29. JUSTICIA. *Corolla* labio superiore concavo, non galeato; inferiore convexo, rugoso. *Stamina* antheris bilocularibus, loculo inferiore calcarato.

30. PTYSSIGLOTTIS. *Corolla* infundibuliformis, limbo labiato, labio inferiore longitudinaliter plicato. *Stamina* antheris bilocularibus, loculis parallelis muticis.

31. MONOTHECIUM. *Corolla* labio inferiore breviter trilobo, plano. *Stamina* antheris unilocularibus.

†† *Capsulæ parietes membranacei per dehiscentiam rupti, placentis a valvis secedentibus.*

32. RUNGIA. *Corolla* labio inferiore biplicato. *Spica* quadrifariam dense bracteata.

Subtribus II. DICLIPTEREÆ.

Corolla tubo elongato, recto vel resupinato; labio inferiore lobo medio maximo, lateralibus linearibus. Bracteæ (excl. Rhinacantho) *calyce multo majores.*

† *Corolla tubo resupinato.*

33. DICLIPTERA. *Capsula* abbreviata, placentis cum retinaculis per dehiscentiam solubilibus.

34. PERISTROPHE. *Capsula* elongata, placentis valvis persistentibus.

†† *Corolla tubo recto.*

35. HYPOESTES. *Bracteæ* tetraphyllæ. *Calyx* laciniis coalitis. *Stamina* antheris bilocularibus. *Flores* in capitulis 3- vel unifloris.

36. RHINACANTHUS. *Calyx* 5-partitus. *Corolla* longe tubulosa, limbo bilabiato. *Stamina* antheris bilocularibus. *Flores* paniculati; bracteis parvis, subulatis.

Subtribus III. GRAPTOPHYLLEÆ.

Corolla tubo abbreviato, dilatato; labio inferiore lobis subæqualibus. Stamina 2 vel 4. Bracteæ parvæ vel nullæ.

37. GRAPTOPHYLLUM. *Stamina* 2, antheris bilocularibus. *Stylus* inclusus. *Bracteæ* minutæ. *Folia* plerumque variegata.

Tribus VI. ASYSTASIEÆ.

Corolla infundibuliformis vel campanulata, raro hypocraterimorpha, æstivatione bilabiata. Stamina 4, 2 sæpe sterilia vel ananthera.

Subtribus I. ERANTHEMEÆ.

Corolla hypocraterimorpha, lobis subæqualibus.

38. ERANTHEMUM. *Stamina* 2, cum rudimentis 2 sterilium; antheris bilocularibus, loculis plus minus divaricatis muticis.

Subtribus II. Euasystasieæ.

Corolla infundibuliformis vel campanulata, lobis æqualibus.

39. Codonacanthus. *Corolla* campanulata, tubo brevissimo. *Stamina* 2; antheris parallelis, loculis basi muticis.

40. Asystasia. *Corolla* infundibuliformis, tubo elongato. *Stamina* 4, omnia fertilia, antheris loculis basi mucronatis.

I. Thunbergia, *Linn. fil.*

Sect. I. *Calycis limbus truncatus.*

1. T. grandiflora, *Roxb. Fl. Ind.* iii. p. 34; *N. ab E. in DC. Prod.* xi. p. 54, *cum syn.*—T. cordifolia, *N. ab E. in DC. l. c.* p. 55.

Var. a flore albo.

Hab. In sylvis tropicis Indiæ orientalis. Sikkim, alt. 1000–4000 ped., *Hook. fil. et T. Thomson*!, *T. Anders.*; Assam, *Griffith*!, *Masters*!, *Jenkins*!; in montibus Khasiæ, *Wallich*!, *Griffith*!, *Hook. fil. et T. Thoms.*!; Chittagong, *Wall. Cat.* 768! Behar ad Sahebgunge prope fluvium Gangem, *T. Anders.*; Bengalia, *Hamilton*!; montibus Nilgiri, *Wight* (an spontanea?); Singapore, *Jack*!; in India boreali-occidentali, *Royle*! *in herb. hort. bot. Calcutt.* In Horto Botanico Calcuttensi culta.

Distr. China ad Macao, *fide N. ab E.*; Hongkong!

This species seems to be confined to the outer tropical region of the eastern Himalaya, the northern parts of Behar, Assam, and the Khasia Hills; Chittagong is apparently its southern limit in the direction of the Burmese territory. The specimen from Singapore, collected by Dr. Jack, and now in the Hookerian Herbarium, is the only one I have seen from the Malayan peninsula. I spent six days in Singapore in 1861, and did not meet with this species; and my collectors, who remained there for six weeks, also failed to discover it. I possess a specimen from Hongkong, where it is probably only cultivated.

2. T. laurifolia, *Lindl. Gard. Chron.* 1856, p. 260.—T. Harrisi, *Hook. Bot. Mag.* t. 4998.—T. grandiflora, var. sinuata, *Wall. Cat.* 768 β et γ.—Hexacentris acuminata, *N. ab E. in DC. l. c.* p. 61, *partim.*

Hab. In Burmah et provinciis Arracan et Tenasserim ad Amherst et Moulmein, *Wallich*!, *Falconer*!; Taongdong, Merdan, Ava, *Wallich*, n. 768 β et γ! et 771!; in insula Thaban, *Helfer*!; Mergui, *Griffith*!; Rangoon, *MacClelland*!, *Cleghorn*!; in horto botanico Calcuttensi culta.

3. T. Hawtaynii, *Wall. Tent. Fl. Nepal.* i. t. 49.—Meyenia Hawtayniana, *N. ab E. in DC. l. c.* p. 60, *cum syn.*

Var. flore albo.

Hab. In montibus Nilgiri, *Hawtayne in herb. Wall.* n. 769 ! et 2516 c !, *Wight* !; in montibus Kurg et Canara, *Law* !, *Gibson*; Bababoodun, *Law* !; in Zeylania, *Walker* ! In H. B. Calcutt. culta.

Var. flore albo, in montibus Nilgiri, *Wight* !, v. s.

4. T. lutea, *T. Anders.*—Nodis interpetiolaribus fimbriatis; foliis ovatis vel lanceolatis, acuminatis, margine dentatis, utrinque hirsutis vel glabris, basi in petiolo decurrentibus; pedunculis oppositifoliis, unifloris, foliis brevioribus; bracteis ovatis, subherbaceis, glaberrimis; corollæ tubo filamentisque pubescentibus; capsula basi turgida, glabra.

Hab. In sylvis temperatis Sikkim ad alt. 6000–9000 ped., *Griffith* !, *Hook. fil. et T. Thoms.* !, *T. Anders.*, v. v.

Planta volubilis. *Radix* tuberosa, perennis. *Caules* annui, tetragoni, glabri, purpurei; nodi interpetiolares ciliis deflexis fimbriati. *Folia* petiolata, 4–7 unc. longa, 2–4 unc. lata; *petiolus* foliis fere dimidio brevior. *Pedunculi* in foliorum axillis solitarii, uniflori, penduli, tetragoni, 4–5 unc. longi. *Bracteæ* æquales, late ovatæ, subherbaceæ, glabræ, 5–7-nerviæ, ante anthesin marginibus adnatæ atque in forma utriculi inflatæ. *Calyx* carnosus, albus; limbus truncatus vel obscure dentatus. *Corolla* infundibuliformis, fauce inflata.

5. T. coccinea, *Wall. Tent. Fl. Nepal.* i. p. 49 et 58, t. 37.—Hexacentris coccinea, *N. ab E. in DC. l. c.* p. 61, *cum syn.*—H. dentata, *N. ab E. in Wall. Pl. As. rar.* iii. p. 78.—H. acuminata, *N. ab E. l. c. partim.*

Hab. In montibus Himalayæ orientalis et centralis, Sikkim, alt. 3000–6500 ped., *Hook. fil. et T. Thoms.* !, *T. Anders.*; Nepal, *Wallich*, n. 766 ! et 7140 !; Kumaon, alt. 2500 ped., *Str. et Winter.* !, *T. Anders.*; Assam, *Griffith* !, *Masters* !, *Jenkins* !, *Simons* !; in montibus Khasia, alt. 3000–4000 ped., *Hook. fil. et T. Thoms.* !, *Oldham* ! In Hort. Bot. Calcutt. culta.

6. T. Mysorensis, *Wight. Icon.* t. 871.

Hab. Ad Walghat in montibus Mysore, *Wight* !, *M'Ivor* !; ad Paulghat, *Beddome* ! n. 122, *in herb. Hort. Bot. Calcut.*

7. T. Wightiana, *T. Anders.*—Schmidia bicolor, *Wight, Icon.* t. 1848.

Hab. In montibus Nilgiri ad Sisparah, *Wight* !

Sect. 2. *Calycis limbus pluridentatus.*

8. T. fragrans, *Roxb. Fl. Ind.* iii. p. 33.—T. lævis, *Wall. et N. ab E. in Wall. Pl. As. rar.* iii. p. 77.—T. Javanica, *Gærtn. fil. Fruct.* iii. p. 22, t. 183.—T. angustifolia, *Ham. et N. ab E. l. c.* p. 78.—T. Roxburghia, *N. ab E. l. c.*

Hab. In montibus Himalayæ orientalis et centralis alt. 1000–4000 ped., Sikkim, *Griffith*! *Hook. fil. et T. Thoms., T. Anders.*; Nepal, *Wall. Cat.* n. 767!; ad Mergui, *Griffith*!; in montibus Nilgiri, *Wight*!, *T. Anders.*; in montibus Malabariæ "Babuboodun" dictis, *Law*!; Concan, *Law*!; in montibus insulæ Zeylaniæ ad alt. 7000 ped., *Thwaites, C. P.* 2020! In Hort. Bot. Calcutt. culta, *Wall. Cat.* 767 K!

Distr. In Java!; insulis Philippinis!; in insulis Indiæ occidentalis culta!

9. T. TOMENTOSA, *Wall. et N. ab E. in Wall. Pl. As. rar.* iii. p. 78.

Hab. In montibus Nilgiri, *Wall. Cat*, n. 767. 4 *ex herb. Heyne, Wight*!; ad Neddiwattam alt. 6500 ped. *T. Anders.*! In Hort. Bot. Calcutt. culta.

This seems entitled to rank as a good species, notwithstanding its similarity in many characters and in habit to *T. fragrans.* The thickened peduncles, peculiar form of the numerous teeth of the calyx, and the large very pubescent capsule are characters which I have observed to be very permanent in the plant cultivated in the Calcutta Botanical Gardens, as well as in many wild specimens I have examined in the Nilgiris. The colour of the corolla is pure white.

T. ALATA, *Bojer in Hook. Exot. Fl.* t. 17; *Wall. Cat.* n. 7141, *Masters*, n. 1332.

Nees von Esenbeck is most certainly in error in giving Assam as an Indian locality of this truly African species. I find, from Dr. Wallich's manuscript Catalogue of the plants in the Calcutta Botanic Gardens, that this species was introduced by seeds received from Mauritius. Dr. Wallich's plant, n. 7141, is a cultivated specimen from the Botanic Gardens, Calcutta. Many of Mr. Masters's plants were collected in the Botanic Gardens, Calcutta, where he was head European gardener for several years; and these seem afterwards to have been distributed along with his Assam collections, but without the locality being always indicated. Mr. Masters informs me that *Thunbergia alata* is unknown in Assam except in gardens, and that it was first introduced from the Calcutta Botanic Gardens about twenty-five years ago by himself. I therefore consider Masters's n. 1332 a garden specimen, although it is quoted by Nees von Esenbeck as a native of Assam. This species is extensively cultivated in gardens in many parts of India.

II. ELYTRARIA, *Vahl.*

1. E. CRENATA, *Vahl, En.* i. p. 106; *N. ab E. in DC. l. c.* p. 63.—E.

marginata, *Pal. de Beauv. in Vahl, En.* i. p. 108.—E. virgata, *N. ab E. in DC. l. c.* p. 63.—E. lyrata, *Vahl, l. c.*

Hab. In planitie Gangetica a Bengal usque ad Panjab, *Wall. Cat.* 2420!, *Griffith*!, *Edgeworth*!. *T. Thomson*!; Carnatic et Circars, *Wight*!; Kurg, *Law*! *in herb. Hook. fil. et T. Thoms.*; in India centrali ad Saugor, *Vicary*!; in Zeylania, *Thwaites, C. P.* 240!

Distr. In Africa occidentali tropica!; ad flumen Zambesi!; atque in regionibus calidioribus Americæ borealis!

III. NELSONIA, *R. Br.*

1. N. TOMENTOSA, *Willd. Sp. Pl.* ed. 2, i. p. 419; *N. ab E. in DC. l. c.* p. 65, *cum syn.*—N. rotundifolia, *R. Br. Prodr. Fl. Nov. Holl.* i. p. 481.—N. nummulariæfolia, *Roem. et Sch. Syst.* i. p. 173.—N. Pohlii, *N. ab E. in Endl. et Mast. Fl. Bras.* fasc. vii. p. 15.—N. canescens, *N. ab E. in DC. l. c.* p. 67, *cum syn.*

Hab. In Bengalia inferiore, ad Calcutta, *Griffith*!, *T. Anders.*; ad Gour, *Vicary*!; Behar ad montem Parasnath, alt. 4000 ped., *T. Thoms. et T. Anders.*; in planitie Gangetica, *T. Thoms.*!; Sikkim, alt. 1000–4000 ped., *Hook. fil. et T. Thoms.*!; in Burmah ad flumina Atran, Salwen et Chappedong, *Wall. Cat.* 2370!; ad Moulmein et Amherst, *Falconer*!; Pegu, *Brandis*!; Sylhet, *Wall. Cat.* 2370!; Assam, *Masters*!, *Simons*!; in Peninsula vulgaris, *Wight*!; Zeylania, *Walker*! *in herb. Hook.* In Hort. Bot. Calcutt. spontanea.

Distr. Herba neglecta, per totum orbem calidiorem diffusa a Nova Hollandia! usque ad Americam!

IV. EBERMAIERA, *N. ab E.*

† *Floribus solitariis axillaribus, vel in cymulis axillaribus congestis.*

1. E. GLAUCA, *N. ab E. in DC. Prodr.* xi. p. 73, *cum syn.*—E. polybotrya, *N. ab E. l. c.* p. 74.

Hab. Per totam Indiam calidam frequens: in Bengalia, *Edgeworth*!, *Hook. fil. et T. Thoms.*; planitie Gangetica superiore, ad Moradabad, *T. Thoms.*!; Lucknow, *T. Anders.*; Deyra Dhoon, *Vicary*!; Saugor, *Vicary*!; Concan, *Stocks*!; Cochin, *Johnstone*!; Assam, *Simons*!; Silhet, *Wall. Cat.* 9087!; in Burmah ad Prome, *Wallich*!; ad Pegu, *Wallich*!, *MacClelland*!; Zeylania, *Thwaites, C. P.* 3575!

Distr. In Java!, insulis Philippinis!; in Australia ad flumen "Fitzmaurice River" dictum!

An examination of a large series of specimens in the Calcutta Herbarium shows that *Ebermaiera humilis* and *E. Zeylanica* are distinct species; in Thwaites's 'Enumeration of the Plants of Ceylon' I united them both with *E. glauca*.

2. E. HUMILIS, *N. ab E. in Wall. Pl. As. rar.* iii. p. 80.
Hab. In montibus Prome, *Wall. Cat.* 7148!

†† *Floribus spicatis.*

3. ZEYLANICA, *N. ab E. in DC. l. c.* p. 74.—E. thyrsoidea, *N. ab E. in Wall. Pl. As. rar.* iii. p. 80.

Hab. In Malabar et Canara, *Law*!; Concan, *Stocks*!; Rangoon, *Cleghorn*!; Moulmein, *Wall. Cat.* 7149!; in Zeylania, *Thwaites, C. P.* 2717!

4. E. STAUROGYNE, *N. ab E. in DC. l. c.* p. 75, *cum syn.*—E. trichocephala, *Miquel, Flor. Ind. Bat.* ii. 774.

Hab. In Silhet, *Wall. Cat.* 4905!; Penang, *Wall. Cat.* 7489!; Malacca, *Griffith*!

Distr. In Sumatra!

5. E. ANGUSTIFOLIA, *T. Anders.*—Staurogyne angustifolia, *Wall. Cat.* 4906.—E. Staurogyne β. *angustifolia, N. ab E. in DC. l. c.* p. 75.—E. Thyrsoidea, *N. ab E. in Wall. l. c.* p. 80 *et DC. l. c.*

Hab. In provincia Tenasserim, *Falconer*, n. 860!; Tavoy et Moulmein, *Wall. Cat.* 4906! et 7149! *partim*; Rangoon, *Scott*!; King's Island, *Helfer*!

6. E. ARGENTEA, *N. ab E. in DC. l. c.*—Staurogyne argentea, *Wall. Pl. As. rar.* ii. p. 80, t. 186.

Hab. In montibus Khasiæ, *Wall. Cat.* 4905!, *Hook. fil. et T. Thoms.*!, *Oldham*!

7. E. SETIGERA, *N. ab E. in DC. l. c.*

Hab. In peninsula Malayana ad Malacca, *Griffith*!

8. E. LONGIFOLIA, *N. ab E. in DC. l. c.* p. 76.

Hab. In peninsula Malayana ad Malacca, *Griffith*!, *Cuming*, n. 2355! *in herb. Hook.*

9. E. SIMONSII, *T. Anders.* Caule simplici, erecto vel basi depresso radicante, pubescente; foliis terminalibus, longe petiolatis, ovato-lanceolatis, acutis, basi attenuatis, margine paulo sinuatis, ciliatis, supra viridibus glabris vel sparse pilosis, subtus pallidis glabris, nervis pubescentibus, petiolis tomentosis rufis; floribus in spicis terminalibus ramosis; bracteis a basi pedicelli solitariis, lineari-lanceolatis, uninerviis, margine breviter ciliatis; bracteolis 2, oppositis, linearibus, calyce brevioribus, setosis; calycibus profunde divisis, segmentis linearibus acutis, 2 superioribus longioribus, omnibus setis hyalinis obtectis; corolla infundibuliformi, tubo curvato, limbo lilacino et albo colorato; capsula calyce breviore, acuta, glabra.

Hab. Assam in locis montanis, ad Gowhatty, *Simons*!, *Jenkins*!, *Masters*, n. 317!; Jyrung Hills, *Simons*!

Planta pedalis. *Caulis, petioli, foliorumque nervi* tomento rufo pubescentes. *Caulis* sæpe depressus, radicans, demum adscendens, basi foliis denudatus. *Folia* herbacea, 4–8 unc. longa, 1–3¼ unc. lata, petiolo 1½–2 unc. longo. *Spicæ* laxæ, basi simpliciter ramosæ, 2–3 unc. longæ. *Calycis* segmenta superiora 5 lin. longa, ½ lin. lata. *Capsula* linearis, glabra, 3 lin. longa.

10. E. VELUTINA, *N. ab E. in DC. l. c.* p. 76.
Hab. Ad Mergui, *Griffith* !; in provincia Tenasserim, *Helfer*, n. 166 !

11. E. AXILLARIS, *N. ab E. in Wall. Pl. As. rar.* iii. p. 80, *et DC. l. c.* p. 75.
Hab. In insula Penang, *Wall. Cat.* 2414 !

12. E. GRIFFITHIANA, *T. Anders.*—Erythracanthus Griffithianus, *N. ab E. in DC. l. c.* p. 78.
Hab. In Malacca, *Griffith* !

13. E. HELFERI, *T. Anders.* Caule abbreviato, simplici, lanato ad nodos, radicante; foliis oppositis, petiolatis, ovatis, apice obtusis, basi attenuatis, margine integris vel sinuatis, utrinque pubescentibus, subtus pallidis venosis; floribus subspicatis; spicis subterminalibus, laxis, bracteatis; bracteis herbaceis, ovatis, obtusis, pubescentibus; bracteolis 2 oppositis, inæqualibus, superiore longiore trinervia et latiore, cetera uninervia; corolla calyce duplo longiore, infundibuliformi, limbi lobis ovatis obtusis.
Hab. In herbario Burmanico Helferiano, no. 51 !; ad Thoungyun, *Brandis* !; ad Moulmein, *Parish* !
Planta herbacea. *Caulis* teres, foliosus, lanatus, 1–2 unc. longus. *Folia* 7–12 unc. longa, 3–4½ unc. lata, petiolo ½ unc. longo. *Spicæ* 2–2½ unc. longæ, pedunculo tereti tomentoso. *Bracteæ* uninerviæ, ovatæ, obtusæ, 3–4 lin. longæ, 2–3 lin. latæ. *Corolla* 10 lin. longa, glabra, purea, fauce elongata, tubo brevi.

††† *Floribus paniculatis, remotis.*

14. E. LASIOBOTRYS, *N. ab E. in DC. l. c. Append.* p. 721.
Hab. In Burmah ad flumen Chappedong, *Wallich* !; ad Mergui, *Griffith* !; Tavoy, *Parish*, n. 117 !; Moulmein, *Falconer*, n. 408 !

15. E. ELONGATA, *T. Anders.*—Erythracanthus elongatus, *N. ab E. in DC. l. c.* p. 78, excl. var. β*.
Hab. In peninsula Malayana ad Penang, *Wallich.*

16. E. RACEMOSA, *T. Anders.*—Erythracanthus racemosus, *N. ab E. in Wall. Pl. As. rar.* p. 80, *et DC. l. c.* p. 78, *cum syn.*
Hab. In sylvis insulæ Penang, *Wall. Cat.* 2336 β !; Singapore, *Wallich* !; Malacca, *Griffith* !

17. E. MERGUENSIS, *T. Anders.* Caule repente vel depresso, radicante; foliis valde petiolatis, oblongis vel ellipticis, basi cordatis apice obtusis, margine sinuatis, supra glabris, subtus tomentosis; paniculis terminalibus, elongatis, plus minus ramosis, pubescentibus; pedicellis alternis, bracteatis; bracteolis 2, minutis, op-

* This variety β of *E. elongata* is a distinct species, to which I have given the name *E. debilis*.

positis, calycis basi adpressis; calycis segmentis lineari-lanceolatis, glabris.

Hab. Ad Mergui, *Helfer*, n. 398!

Caulis floccoso-tomentosus, elongatus, repens, radicans, seu depressus, ad nodos radices emittens. *Folia* variabilia sed semper basi valde cordata, supra viridia glabra, subtus pallidiora (in siccis rubescentia), 2–4 unc. longa, 1–2½ unc. lata, petiolo floccoso-tomentoso; nervi subtus pubescentes. *Paniculæ* solitariæ, erectæ vel a basi ramosæ, 6–9 unc. longæ. *Pedicellus* filiformis, 2 lin. longus. *Calyx* pedicellum æquans. *Corolla* ignota.

18. E. GRACILIS, *T. Anders.* Caule fere nullo, nodoso, radicante; foliis breviter petiolatis, obovato-lanceolatis vel obovatis, acutis, margine obsolete crenulatis, sinuatis, utrinque hirtellis, subtus albidis, nervis prominentibus pubescentibus; paniculis elongatis, gracilibus, alternatim ramosis, tomentosis; floribus remotis, alternis, bracteatis; bracteis solitariis, subulatis; bracteolis minutis, oppositis, subulatis, acutis, calycem longitudine æquantibus; calycis segmentis brevibus; corolla tubulosa, elongata, curvata, angusta, extus pubescente; capsula parva, lanceolata, acuta, glabra.

Hab. Ad Zing-gike prope Martaban, *Parish*, 24!, *Griffith*!

Planta erecta. *Caules, folia* et *paniculæ* pubescentes. *Folia* approximata, breviter petiolata, 4–8 unc. longa, 2–3½ unc. lata. *Paniculæ* foliis longiores, ramosæ. *Bracteæ* 2–4 lin. longæ, ad basin ramorum paniculæ pedicellorumque positæ. *Corolla* calyce triplo longior.

19. E. OBTUSA, *T. Anders.*—Erythracanthus obtusus, *N. ab E. in DC. l. c.* p. 78.

Hab. In provincia Tenasserim ad Mergui, *Griffith*!; ad Moulmein, *Falconer*, n. 417!

20. E. PANICULATA, *Wall. in herb. Hort. Bot. Calcutt. absque descript.* Caule erecto, tereti, tomentoso, rubescente; foliis oppositis, petiolatis, oblanceolatis, acutis, basi attenuatis, margine fere integris, supra viridibus glabris, subtus pallidis pulcherrime venosis; paniculis terminalibus, gracilibus, rubicundis, ramis elongatis filiformibus; pedicellis brevibus, basi minute bracteatis; calyce profunde et æqualiter 5-partito, segmentis linearibus, pubescentibus; corolla infundibuliformi, pubescente, limbi lobis æqualibus pubescentibus; antheris loculis divaricatis, subreflexis, connectivo basi dilatato; stigmate bilobo; capsula fere cylindrica, glabra, acuta, valvis lignosis sulcatis.—E. venosa, *T. Anders. in herb. Hook.*

Hab. Ad Munipur, "E Munipur misit Sabir Mahomed, Iunii 25, 1834," *vide sched. Wallichianam in herb. Hort. Bot. Calcutt.*!; in Burmah, *Griffith*!

Planta pedalis, rubescens. *Caules, petioli nervique* pubescentes. Ceterum (corolla et calyce exceptis) glabra. *Folia* decussata, 4–8 unc.

longa, ½–3 unc. lata, petiolo ½ unc. longo. *Paniculæ* folia multo superantes, pauce ramosæ. *Flores* secundæ, minutissime bracteatæ. *Bracteæ* subulatæ. *Calyx* 2 lin. longus, segmentis lineari-lanceolatis.

21. E. MACCLELLANDII, *T. Anders.* Caule erecto, tereti, gracili, subglabro; foliis oppositis, petiolatis, lanceolatis, margine integris, utrinque glabris; paniculis axillaribus atque terminalibus, pilis patentibus incanis, ramis graciliter filiformibus; bracteis lanceolatis vel linearibus, incanis; pedicellis filiformibus; calycis segmentis æqualibus, linearibus, corolla brevioribus, pilis setosis obtectis; corolla infundibuliformi, glabra, tubo curvato; stigmate lobis linearibus, lobo breviore bifido; capsula calyce breviore, subovata, submucronata, glabra.—Ebermaiera, n. 15, *in herb. Hook. fil. et T. Thoms.*

Hab. Ad Pegu, *MacClelland*! *in herb. Hook.*

Planta gracilis, herbacea, inflorescentia incana, ceterum subglabra. *Caulis* teres, internodiis valde elongatis. *Folia* caulina 1–1½ unc. longa, basi in petiolum attenuata. *Bracteæ* 2–6 lin. longæ. *Calyx* 4 lin. longus. *Corolla* 6 lin. longa, tubo infra medium paulo curvato.

V. ADENOSMA, *N. ab E.*

1. A. BALSAMEA, *Spr. Syst.* ii. p. 829.—*N. ab E. in DC. l. c.* p. 68, *cum syn.*

Hab. In locis humidis et oryzetis, Carnatic, *G. Thomson*!, *Shute*!; in montibus Nilgiri et ad Courtallum, *Wight*!; Zeylania, *Gardner*!, *Thwaites C. P.* 1996!, *Wall. Cat.* 9082 c!

2. A. VERTICILLATA, *N. ab E. in Wall. Pl. As. rar.* iii. p. 79, *in DC. l. c.* p. 69.

Hab. In Canara et Mysore, *Law*!; Concan, *Stocks*!, *Gibson*!; in Zeylania, *C. P.* 1995!, *Wall. Cat.* 2409!

3. A. BIPLICATA, *N. ab E. in Wall. l. c., in DC. l. c.* p. 68.—Synnema Avanum, *Benth. in DC. Prodr.* x. p. 538.

Hab. In Burmah, ad Prome, *Wall. Cat.* 7146!; Pegu, *R. Scott*!, *MacClelland*! *in herb. Hook. fil. et T. Thoms.*

4. A. TRIFLORA, *N. ab E. in Wall. l. c., in DC. l. c.* p. 68, *cum syn.*

Hab. In locis udis et paludibus, Bengalia inferiore, *Roxburgh*!, *Wall. Cat.* 7147!, *Edgeworth*!, *Hook. fil. et T. Thoms.*!, *T. Anders.*; Behar, *T. Thoms.*! *et T. Anders.*; ad Dinagepur, *Vicary*!; Assam, *Simons*!; Silhet, *Griffith*!; Dacca, *Hook. fil. et T. Thoms.*!; Singapore, *G. Thoms.*!, *T. Anders.* In hort. Bot. Calcutt. spontanea!

Distr. In insulis Vitiensibus, *Seeman*!

5. A. THYMUS, *N. ab E. in Wall. l. c., in DC. l. c.* p. 69, *excl. syn. Roxb. et Rumph.*

Hab. In peninsula Indiæ orientalis, *Heyne in Wall. Cat.* 2380 B!

6. A. GRIFFITHII, *T. Anders.* Caulibus diffusis, radicantibus, pubescentibus; foliis oppositis, ovatis, spathulatis, caulinis petiolatis,

floralibus sessilibus, apice rotundatis, basi attenuatis, margine serratis, supra sparse hirsutis, subtus setosis; floribus spicatis; bracteis foliosis plus minus imbricatis; floribus in axillis bractearum binis vel ternis, sessilibus, rarissime pedunculatis; calycis segmentis linearibus, acutis, æqualibus, breviter ciliatis, capsulam æquantibus; corolla parva, tubulosa, glabra, limbo bifido subringente, labiis minute bi- et trifidis; staminibus inclusis, antheris ovatis; capsula lineari, acuta, glabra, polysperma, valvis compressis sulcatis.

Hab. Bengaliam in locis udis, *Griffith*!; Assam, *Jenkins*!

Herba neglecta, diffusa, pubescens. *Caulis* radicans, teres, pubescens. *Rami* subtetragoni. *Folia* 1–3 unc. longa, ½–1½ unc. lata. *Bracteæ* solitariæ, ovatæ, serratæ. *Bracteolæ* calycis segmentis breviores. *Calyx* fere ad basin 5-partitus 3½ lin. longus. *Corolla* tubulosa, calyce paulo longior, glabra. *Capsula* vix 4 lin. longa.

7. A. PINNATIFIDA, *T. Anders.*—Nomaphila pinnatifida, *Dalz. in Hook. Journ. of Bot.* iii. p. 38.

Hab. In Concan, *Stocks*!, *Law*!, *Dalzell*!

8. A. ULIGINOSA, *R. Br. Prodr. Fl. Nov. Holl.* i. p. 442; *N. ab E. in DC. l. c.* p. 69.

Hab. In agris oryzaceis Indicis, Carnatic, *Wight*!; Bengalia, *T. Thoms.*!; regione tropica Sikkimensi, *herb. Hort. Bot. Calcutt.*!; Zeylania, *Walker*! *in herb. Hook.*

9. A. THWAITESII, *T. Anders. in Thwaites En. Pl. Zeyl.* p. 224.

Hab. In Zeylania, ad districtum Batticaloa, *C. P.* 1994!

Nees von Esenbeck seems to have overlooked Mr. Bentham's removal of Wallich's plant, n. 3852 of the Catalogue, to *Pterostigma*, a genus of Scrophularineæ, as that number is described in the Prodromus, xi. p. 68, as *Adenosma villosa*, Benth. in herb. Monac.

VI. NOMAPHILA, *Blume.*

1. N. PARISHII, *T. Anders.* Caule adscendente, tetragono, sulcato, juniore pubescente; foliis petiolatis, ovatis, lanceolatis, basi attenuatis, margine integris, utrinque tomentosis; floribus in cymis dichotomis lateralibus; bracteis 2, parvis, lanceolatis, tomentosis, bracteolis nullis; calycis segmentis linearibus, acutis, margine setose ciliatis, uno ceteris paulo longiore; corolla infundibuliformi, limbo personato, bilabiato, labio superiore breviter bifido, inferiore trifido, intus inflato, corrugato, barbato; capsula elongata, lineari, polysperma, acuta, valvis compressis, profunde sulcatis; seminibus parvis, suborbiculatis.

Hab. In Tenasserim, *Falconer*, n. 418!, *Parish*, n. 119!; Martaban et Pegu, *Brandis*!

Herba fere 2-pedalis. *Caulis* parte inferiore subtereti, cinerea, superiore valde tetragona, sulcata, lurida. *Folia* variabilia, 2–8 unc. longa,

majora ovata lanceolata, minora lanceolata. *Calyx* pubescens, ½ unc. longus, ad basin 5-partitus, segmentis linearibus. *Corolla* uncialis, purpurea? *Capsula* calyce paulo longior, glabra; valvis 1 lin. latis, mucronatis, placentis retinaculis parvis erectis.

Nomaphila stricta, N. ab E. in DC. Prodr. xi. p. 84, said to have been found in India by König, is probably confined to Java and the islands of the Malayan archipelago. I have seen it in the forests of Java, but I know of no specimens said to be from the continent of Asia except those referred to by Nees von Esenbeck.

VII. Hygrophila, *R. Br.*

† *Staminibus antheriferis duobus.*

1. H. polysperma, *T. Anders.*—Hemiadelphis polysperma, *N. ab E. in Wall. Pl. As. rar.* iii. p. 80; *in DC. l. c.* p. 80.

Hab. Per Indiam tropicam in humidis diffusa; in Himalaya tropica a Bhotan usque ad Jamu, *Griffith*!, *Booth*!, *Strach. et Winterb.*!, *Hook. fil. et T. Thoms.*!; Oude, *Wall. Cat.* 2483!; Rohilcund et Punjab, *T. Thoms.*!; Affghanistan, *Griffith*!; Banda, *Edgeworth*!; Sind, Canara et Concan, *Stocks*!; Dacca, *Hook. fil. et T. Thoms.*!; Assam, *Jenkins*!, *Masters*!, *Simons*!; Silhet, *Gomez*! *in herb. Wall.*; Chittagong, *Hook. fil. et T. Thoms.*!; Rangoon, *M'Clelland*!; Malacca, *Griffith*!; Bengalia ad Calcutta, *T. Anders.*; Bhaugulpore in provincia Behar, *Vicary*!

†† *Staminibus fertilibus quatuor.*

2. H. Serpyllum, *T. Anders.*—Physichilus Serpyllum, *N. ab E. in DC. l. c.* p. 81.

Hab. In Mysore, *Wight*!; Malabar, *Law*!; Concan et Sind, *Stocks*!; in India centrali ad Jubbulpore, *Beddome*!; Banda, *Edgeworth*!; Sambulpore, *Griffith*!

This is evidently a variable plant, and is much influenced by the nature of the soil in which it is found. Some luxuriant forms of it were distributed in the Indian Herbarium of Drs. Hooker and Thomson under the numbers, *Physichilus*, sp. 2, 3, & 4. The plant is not widely distributed over India, and is therefore rather rare in herbaria.

3. H. salicifolia, *N. ab E. in Wall. l. c.* p. 81; *in DC. l. c.* p. 92, *cum syn.*

Var. α. glabra, *T. Anders.*—H. quadrivalvis, *N. ab E. in Wall. l. c.* p. 80.—H. obovata, *N. ab E. l. c.* p. 81, *cum syn.*—H. undulata, *N. ab E. l. c., cum syn.*—H. radicans, *N. ab E. l. c.*—H. angustifolia, *R. Br. in Prodr. Fl. Nov. Holl.* p. 479.

Var. β. hirsuta, *T. Anders.*—Ruellia hirsuta, *Roxb. Fl. Ind.* iii. p. 51.—

H. phlomoides, *N. ab E. in Wall. l. c.* p. 80.—H. incana, *N. ab E. in DC. l. c.* p. 91.—H. assurgens, *N. ab E. l. c.* p. 90.

Hab. Herba in marginibus paludum atque in fossis vulgatissima a Zeylania usque ad Panjab. *a* : in peninsula Malayana et Burmah ; in Bengalia, *Wall. Cat.* 2373! et 2375!; ad Calcutta, *T. Thoms.*! *et T. Anders.*; Behar, *T. Thoms. et T. Anders.*; in Assam, *Masters*!; Silhet, *Wall. Cat.* 2373! 2410!, *ex herb. Heyne. Wall. Cat.* 2373!, *ex herb. Madras,* 2374!; in provinciis Maisor et Carnatic, *G. Thoms.*!; Malabar, *Law*!; Concan, *Stocks*!; in Burmah ad Rangoon, *Cleghorn,* n. 167!; Tavoy, *Wall. Cat.* 2374!; Malacca, *Griffith*! *β*: in Silhet, *Wall. Cat.* 2376, A et B!; in Bengalia, *T. Thoms.*!; Sikkim in regione tropica, alt. 1000–3000 ped., *Hook. fil. et T. Thoms.*; in montibus Khasiæ, *Griffith*!, *Hook. fil. et T. Thoms.*!; Assam, *Jenkins*!, *Simons*!, *Masters*!; in montibus "Naga Hills" dictis, *Masters*!

Distr. In Java!; insulis Philippinis!; China!; Japonia!; Australia tropica!

I have hesitated to add the North and South American species of *Hygrophila* to the synonymy adduced for this species. When I examined the American species of this genus in the Hookerian Herbarium, which contains Nees von Esenbeck's authentic specimens, I failed to detect any of the specific differences detailed by that author in the 'Prodromus.' The slight distinction that existed among the various specimens seemed to me to be no greater than ought to be found in a very common species of aquatic weed extending over many degrees of latitude. I am convinced of the correctness of referring all Nees von Esenbeck's so-called Asiatic species of *Hygrophila* to one widely-diffused plant. I have seen examples of nearly all his so-called Asiatic species growing within a few yards of each other in ditches by roadsides both in Bengal and Java, the differences between each specimen being evidently caused by that in the amount of moisture to which each was exposed.

4. H. SPINOSA, *T. Anders. in Thwaites's Enum. Pl. Zeyl.* p. 225, *et in Journ. Linn. Soc., Bot.* vol. vii. p. 22, *cum syn.*—Asteracantha longifolia, *Nees.*

Hab. Herba per Indiam tropicam in aquosis a Zeylania ad Himalayæ basin vulgatissima; in Nepal, *Wall. Cat.* 2505; in Burmah ad Pegu, *Scott*!; Prome, *Wall. Cat.* 2505!

Distr. In Africa tropica!

VIII. CYSTACANTHUS, *T. Anders.*

Bracteæ duæ, oppositæ, parvæ, a calyce remotæ. *Calyx* ad

basin 5-partitus, laciniis æqualibus, elongatis. *Corolla* inflata, campanulato-infundibuliformis, paulo curvata, tubo brevi; limbo apice contracto, æqualiter 5-dentato, dentibus brevibus rotundis vel acutis. *Stamina* inclusa duo, cum rudimentis duorum sterilium; filamentis rotundis, glabris, ad basin geniculatis barbatis; antheris bilocularibus; loculis lineari-ovatis, æqualibus, hirsutis, basi muticis; connectivo submucronato. *Ovarium* ovatum, hirsutum, stylo, tereti subglabro; stigmate brevissime bifido. *Capsula* linearis, 12-sperma, apice obtusa; valvis a dorso compressis, profunde sulcatis. *Semina* ovata, compressa, tomentosa; retinaculis incurvis, subulatis, acutis.

1. C. PANICULATUS, *T. Anders.* Caule tetragono, subulato, glabro; foliis ovatis vel lanceolatis, longe acuminatis, basi in petiolo decurrentibus, margine undulato-crenatis, supra glabris, infra ad nervos pubescentibus; floribus paniculatis; paniculis terminalibus, viscoso-tomentosis, multifloris, floribus pedunculatis; bracteis linearibus, acutis, tomentosis; calycis laciniis herbaceis, anguste linearibus, acutis, omnino dense viscoso-tomentosis; corolla ampla, extus viscosa, intus glabra, portione inferiore (labio inferiore) saccata, limbo 5-dentato, dentibus æqualibus rotundatis obtusis; capsula lineari, viscoso-tomentosa, seminibus remotis.

Hab. Ad Moulmein, *Lobb*! *in herb. Hook.*

Planta herbacea? erecta, basi glabra, superne viscoso-tomentosa. *Caulis* junior ad angulos alatus. *Folia* cum petiolo 3–6 unc. longa, 1–2 unc. lata, decussata, in petiolo breviter decurrentia. *Bracteæ* 2 lin. longæ. *Calycis* laciniæ $3\frac{1}{2}$–5 lin. longæ $\frac{1}{2}$ lin. latæ, utrinque pubescentes. *Corolla* 1–$1\frac{1}{4}$ unc. longa, limbo in sicco $\frac{1}{2}$ unc. lato. *Capsula* 1 unc. longa, 2 lin. lata; valvis sublignosis, extus molliter tomentosis, viscosis, sulcatis et longitudinaliter striatis.

2. C. CYMOSUS, *T. Anders.* Caule erecto, ramoso, subtetragono, basi glabro, superne viscoso; foliis petiolatis, lanceolatis, acuminatis, utrinque velutinis, infra pallidioribus, fere incanis; floribus in cymulis paucifloris axillaribus, pedunculis viscosis, bracteis duabus linearibus; calycis laciniis lineari-lanceolatis, viscosis; corolla extus viscosa, intus glabra, limbo dentibus parvis acutis subæqualibus; rudimentis staminum sterilium setaceis barbatis; capsula lineari, apice obtusa, valvis sulcatis pluristriatis.

Hab. In Burmah ad Hoandro, *Brandis*! *in herb. Hort. Bot. Calcutt.*

Planta suffruticosa. *Caulis* inferior teres, lignosus; superior tetragonus, herbaceus. *Rami* elongati, adscendentes. *Cortex* cinereus, integer. *Folia* decussata, mollissima, velutina, 3–4 unc. longa, $\frac{3}{4}$–$1\frac{1}{2}$ unc. lata; petiolo 1 unc. longo, velutino. *Bracteæ* 2 lin. longæ. *Calycis* laciniæ 7–8 lin. longæ, 1 lin. latæ, acutæ, pilis viscosis obtectæ. *Co-*

rolla inflata, 1–1¼ unc. longa; tubo brevissimo. *Capsula* 1¼ unc. longa, 2½ lin. lata, tomentosa; valvis compressis, pluristriatis, medio profunde sulcatis. *Semina* remota.

IX. Echinacanthus, *N. ab E.*

1. E. attenuatus, *N. ab E. in Wall. Pl. As. rar.* iii. p. 90; *in DC. Prodr. l. c.* p. 168, *cum syn.*

Hab. In Nepalia, 2000–4000 ped., *Wall. Cat.* 2345!, *Hook. fil.*!; Assam, *Jenkins*!

2. E. parviflorus, *T. Anders.* Caule tereti; foliis petiolatis, ovatis, acuminatis, basi inæqualibus, margine serratis, utrinque glabris; floribus paniculatis; paniculis terminalibus axillaribusque, terminalibus laxe ramosis; floribus oppositis, sessilibus; bracteis linearibus, bracteolis minutis; calyce usque ad basin 5-partito, glabro; segmentis æqualibus, linearibus, acutis, integris, uninerviis; corolla recta, glabra, calyce triplo longiore, infundibuliformi, tubo brevi, lobis parvis rotundis; capsula compressa, mucronulata, octosperma, valvis sulcatis margine costatis; seminibus parvis, compressis.

Hab. In montibus Khasiæ, *Griffith*!, *Simons*! *in herb. Hort. Bot. Calcutt.*

Planta erecta, divaricata, glabra. *Caulis* teres. *Folia* longe petiolata, basi oblique rotundata, supra minute lanceolata, 3–6 unc. longa, 2–3 unc. lata, petiolo 2–3 unc. longo. *Paniculæ* terminales, ramosæ, divaricatæ, erectæ, 6–10 unc. longæ. *Rachis* sæpe secundiflora. *Paniculæ* axillares, foliis breviores, parce ramosæ, patentes. *Bracteæ* 3–4 lin. longæ. *Bracteolæ* minutæ. *Calyx* erectus, bracteis et capsula vix longior; segmentis omnino æqualibus. *Corolla* utrinque glabra, portione infundibuliformi ¾ unc. longa, tubo ¼ unc. longo.

I have seen nothing that can be referred to Nees von Esenbeck's *E. Brugmansianus*.

X. Calophanes, *Don.*

1. C. vagans, *Wight, Icon. Plant. Ind. Or.* t. 1526.—Dipteracanthus vagans, *Benth. in herb. Hook.*

Hab. In Kurg, *Wight*!; Canara, *Law*!; Concan, *Gibson*!, *Stocks*!

Dr. Gibson says that this species is "strong-smelling."

2. C. Nagchana, *N. ab E. in DC. Prodr. l. c.* p. 109, *cum syn.*

Hab. In planitie Gangetica ad Patna, *Hamilton in Wall. Cat.* 2396!

3. C. depressa, *T. Anders. in Thwaites's Enum. Pl. Zeyl.* p. 225.—Dyschoriste depressa, *N. ab E. in Wall. l. c.* p. 81.—D. cernua, *N. ab E. l. c.* p. 106.

Hab. In Behar, *Hook. fil.*!; in India australi ad Tanjore et Madras, *Wight*!, *Shuter*!, *in herb. Hook. Beddome*!, *in herb. Hort. Bot.*

Calcutt. Wall. Cat. 2379 !; in Zeylania, *Wall. Cat.* 2379 !, *Thwaites, C. P.* 3537 !

4. C. LITTORALIS, *T. Anders. l. c.*—Dyschoriste littoralis, *N. ab E. l. c.*

Hab. In locis aridis Indiæ australis et Zeylaniæ; Maisor et Carnatic, *G. Thoms.* !, *Wall. Cat.* 2381 ! *ex herb. Wight.*; in regione septentronali insulæ Zeylaniæ, *Thwaites, C. P.* 1997 !

XI. RUELLIA, *Linn.*

1. R. REPENS, *Linn. Mant.* p. 89.—Dipteracanthus lanceolatus, *N. ab E. in Wall. Pl. As. rar.* iii. p. 82, *in DC. Prodr. l. c.* p. 124.

Hab. In littoribus siccis peninsulæ Malayanæ, ad Mergui et Malacca, *Griffith* !; Singapore, *T. Anders.*; in Zeylania, prope Galle, *T. Thoms.* !

Distr. In Java !; insulis Philippinis !; China!

2. R. PROSTRATA, *Poir. Enc. Méth.* vi. p. 349.—Dipteracanthus prostratus, *N. ab E. in Wall. l. c.* p. 81, *in DC. l. c.* p. 124.—D. dejectus, *N. ab E. in Wall. l. c.* p. 82, *DC. l. c.* p. 125.—Ruellia ringens, *Roxb. Fl. Ind.* iii. p. 44.

Hab. Per totam Indiam tropicam vulgatissima a Point de Galle in Zeylania usque ad Punjab; in Bengalia, *Griffith* !; Behar, *T. Anders.*; ad Maldah, *Vicary* !; ad Lucknow, *T. Anders.*; in Rohilcund, *T. Thoms.* !; Saharunpore, *Royle* !; in planitie Carnatic et Maisor, *G. Thoms.* !; ad Arcot, *Griffith* !; Concan, *Stocks* !, *ex herb. Wight. in Wall. Cat.* 2384 !; Burmah prope puteos petroleos, *Wall. Cat.* 7186 !; ad Meaday, *Scott* ! In Hort. Bot. Calcutt. indigena.

Distr. In Africa austro-orientali prope fluvium Zambesi !

3. R. PATULA, *Jacq. Misc.* ii. p. 358.—Dipteracanthus patulus, *N. ab E. in DC. l. c.* p. 126, *cum variet.*—D. erectus, *N. ab E. in Wall. Pl. As. rar.* iii. p. 82.

Hab. In locis siccis provinciarum Carnatic, Maisor et Concan, *G. Thoms.* !, *Stocks* !, *Wight* !, *Cleghorn* !; in Zeylania, ad Trincomalee, *Glennie* ! *C. P.* 3628 !

Distr. In Arabia felici ad Aden !; in Africa ad Sennaar ! et Elephant's Bay !

4. R. LONGIFOLIA, *Stocks, in Kew Journ. of Bot.* iv. p. 177.

Hab. In arenosis Sind et Beloochistan, *Stocks* !

5. R. CERNUA, *Roxb. Fl. Ind.* iii. p. 45.

Hab. In Maisor, *Hamilton*; in monte Parasnath in sylvis tropicis ad alt. 3000 ped., *T. Thoms. et T. Anders.*; in India centrali, ad Jubbulpore, *Beddome*, n. 13 ! (v. v.).

Nees von Esenbeck, in the 'Prodromus,' quotes this as a synonym of *Adenosma Thymus*. The plant collected by Dr. Thomson

and myself is certainly the *R. cernua* of Roxburgh's 'Flora Indica' and of his drawings in the library of the Calcutta Botanic Gardens; it is a true *Ruellia*.

6. R. CILIATA, *Hornem. Hort. Bot. Haf.* ii. p. 585.—Dipteracanthus ciliatus, *N. ab E. in Wall. l. c.* p. 87; *DC. l. c.* p. 120.
Hab. Burmah, in montibus prope Prome, *Wall. Cat.* 7151! In Hort. Bot. Calcutt. culta.

7. R. SUFFRUTICOSA, *Roxb. Fl. Ind.* iii. p. 53.—Dipteracanthus Sibua, *N. ab E. in Wall. l. c.* p. 81; *DC. l. c.* p. 121, *cum syn.*
Hab. In planitie Gangetica ad Dinagepur, *Roxb.*!; Moradabad, *T. Thoms.*! *in herb. Ind. Or. Hook. fil. et T. Thoms., Dipteracanthus,* n. 8.

There is a species of *Ruellia* contributed to the Calcutta Herbarium by Colonel Eyre, from Pegu, and which I cannot refer to any of the above species. It is evidently new, but the specimens are too imperfect to admit of description.

XII. PETALIDIUM, *N. ab E.*

1. P. BARLERIOIDES, *N. ab. E. in Wall. Pl. As. rar.* iii. p. 75 et 82; *in DC. Prodr.* xi. p. 114, *cum syn.*
Hab. In dumetis Himalayæ subtropicæ et in collibus Behar et Indiæ centralis australisque; in Sikkim tropico, *H. fil. et T. Thoms.* !, *T. Anders.*; in provincia Kumaon, *T. Anders.*; in valle "Deyra Dhoon" dicta, *Wall. Cat.* 2389!; in Monte Parasnath, *Hook. fil.*!, *T. Thoms.*! *et T. Anders.*; in India centrali ad Nagpur, *Jerdon*!; in montibus Malabar et Concan, *Stocks*!, *Law*!

XIII. PHAYLOPSIS, *Willd.*

1. P. PARVIFLORA, *Willd. Sp. Pl.* iii. 342.—Ætheilema reniforme, *N. ab E. in Wall. Pl. As. rar.* iii. p. 94; *in DC. l. c.* p. 261, *cum syn.*
Hab. In dumetis montosis tropicis Indiæ a Zeylania usque ad Assam; in Bengalia, *Hook. fil. et T. Thoms.*!; Assam ad Seebsagor, et Gowhatty, *Masters*, 1029!, *Jenkins*!; in montibus Naga, *Simons*!; in montibus Anamallay, *Beddome*!; Canara et Maisor, *Law*!; Concan, *Gibson*!; in montibus Prome et Taong Dong, *Wall. Cat.* 2353!; in Zeylania, *Thwaites, C. P.* 398!
Distr. In insulis Madagascar! et Pemba!; Senegambia!

XIV. HEMIGRAPHIS, *N. ab E.*

1. H. DURA, *T. Anders.*—Ruellia dura, *N. ab E. in DC. Prodr. l. c.* p. 146.—R. crispa, *Roxb. in herb. propr.*; *N. ab E. in DC. l. c., sed non Linn.*

Hab. In montosis Malabar et Concan, *Stocks*!, *Law*!, *Gibson*!; in planitie Maisor, *Cleghorn*!

2. H. HIRTA, *T. Anders.*—Ruellia hirta, *Vahl, Symb.* iii. p. 84, t. 67, *et N. ab E. in DC. l. c.* p. 145.—R. latebrosa, *Roxb. Fl. Ind.* iii. p. 46. —R. sarmentosa, *N. ab E. in Wall. Pl. As. rar.* iii. p. 83.—Hemigraphis latebrosa, *N. ab E. in DC. l. c.* p. 723, *partim.*

Hab. In graminosis per Bengaliam divulgata, in planitie Gangetica superiore frequens; ad Calcutta, indigena in horto botanico, *Wall. Cat.* 2382!, *Griffith*!; Jessore, *Parry*!, *Hook. fil. et T. Thoms*!; ad Kuworikot, *Ham. in Wall. Cat.* 2382 E!; ad Bareilly, *T. Anders.*; Umballah, *Edgeworth.*

A great deal of confusion exists in the 'Prodromus' about this species. Vahl's *Ruellia hirta*, as described by Nees at p. 145 of the eleventh volume of the 'Prodromus,' is the plant I recognize as *Hemigraphis hirta.* In the synonymy of *R. hirta* at p. 146, Nees quotes *R. latebrosa*, Roxb., of the Flora Indica, iii. p. 46, et herb. I have seen Roxburgh's specimen; it is the same as Vahl's species.

So far Nees von Esenbeck's determination is correct; and had he been satisfied with his elucidation of this by no means difficult species, no charge of having caused confusion could have been made.

Among the addenda at p. 722 of the 'Prodromus,' the genus *Hemigraphis* occurs for the first time, and is marked xxxii. bis, as coming before *Ruellia.* The second species of this genus (vide *DC. Prodr.* xi. p. 723) is *H. latebrosa*, Roxb. Fl. Ind. iii. p. 46 (following the method adopted by Nees in all other similar cases, *R. latebrosa*, Roxb., should appear in the synonymy, as Roxburgh's name cannot properly be appended to a species of a genus not constituted till 1847), the same as already quoted in the synonymy of *R. hirta* at p. 146 of the 'Prodromus.' I have not had an opportunity of examining all the specimens referred to by Nees as belonging to this so-called species of *Hemigraphis*; but the following Wallichian numbers, which he cites, belong to *H. elegans*, in all the Herbaria I have had access to, Wall. Cat. 2383, 2394 & 2395. Wight's figure in the Icones, 1504, is a very good illustration of this species, though Wight refers it to *H. latebrosa*, Nees.

3. H. RUPESTRIS, *T. Anders.*—Ruellia rupestris *et* R. ebracteolata, *Dalz. in Hook. Journ. of Bot.* ii. p. 342.

Hab. In Malabar et Concan, *Law*!, *Stocks*!, *Dalzell.*

4. H. ELEGANS, *N. ab E. in DC. Prodr. l. c.* p. 722.—H. latebrosa, *N. ab E. l. c.* p. 723, *partim.*—Ruellia Pavala, *Roxb. Fl. Ind.* iii. p. 47.

Hab. In locis montosis, Behar ad montem Parasnath, alt. 4000 ped., *Hook. fil.* !, *T. Thoms.* !, *T. Anders.*; in Himalaya boreali-occidentali ad alt. 2000–4000 ped., *Royle* !, *T. Thoms.* !; ad portas Heerapur et Khanseran, *Vicary* !; Sumbulpur, *Griffith* !; Malabar et Concan, *Stocks* !, *Law* !, *Gibson* !; Rangoon, *Scott* !; Taong Dong et in montibus contra Prome, *Wall. Cat.* 2383 !

At p. 160 of the 'Prodromus,' Nees refers *Ruellia Pavala*, Roxb., to *Lepidagathis Pavala*; but this specific name has not been given to any species of *Lepidagathis*.

Roxburgh's coloured figure of *R. Pavala* exists in the Library of the Royal Botanic Gardens; and this drawing shows that Nees was in error in referring Roxburgh's plant to *Lepidagathis*. Under *R. confinis*, at p. 148, Nees says, "An hujus loci *Ruellia Pavala*, Roxb. Fl. Ind. Or. iii. p. 47?"

5. H. QUADRIFARIA, *T. Anders.*—Ruellia quadrifaria, *Wall. Cat.* 7152; *N. ab E. in Wall. Pl. As. rar.* iii. p. 83, *DC. l. c.* p. 147.

Hab. In montibus Taong Dong, *Wall. Cat.* 7152 !; in Tenasserim, *Parish*, 403 !

6. H. GRIFFITHIANA, *T. Anders.*—Ruellia Griffithiana, *N. ab E. in DC. l. c.* p. 149.

Hab. Ad Mergui in Tenasserim, *Griffith*, n. 1006 !

7. H. CONFINIS, *T. Anders.*—Ruellia confinis, var. β, foliis obtusis, *N. ab E. in DC. l. c.* p. 148.

Hab. In peninsula Malayana ad Malacca, *Cuming*, 2354 !, *Griffith* ! *in herb. Hook., Wight. et Hort. Bot. Calcutt.*

Distr. In insulis Philippinis.

I have no doubt that Nees von Esenbeck's var. α is also referable to this species; but as I have not seen a specimen, I do not venture to quote it. The identification of Nees's species is obscured by the concluding remark, "an hujus loci *Ruellia Pavala*, Roxb. Fl. Ind. iii. p. 47?" As I have just shown, he in another place refers *R. Pavala* to *Lepidagathis*.

XV. STENOSIPHONIUM, *N. ab E.*

1. S. ZEYLANICUM, *T. Anders. in Thwaites's Enum. Pl. Zeyl.* p. 225.

Variat α foliis serratis, β foliis margine integris.

Hab. Var. α in provinciis Bintenne et Batticaloa insulæ Zeylaniæ, *Thwaites*, *C. P.* 3577 !; var. β in provincia centrali Zeylaniæ, *C. P.* 3661 !

2. S. CONFERTUM, *N. ab E. in DC. Prodr.* xi. p. 105.—S. diandrum, *N. ab E. l. c. partim.*

Hab. In pratis siccis montium Nilgiri, *Wight*!, *T. Anders.*; in montibus prope Courtalam, *Wight*!

General Walker's specimens from Ceylon in the Hookerian Herbarium, referred by Nees von Esenbeck to *S. diandrum*, belong to *S. Russellianum*.

3. S. RUSSELLIANUM, *N. ab E. in Wall. Pl. As. rar.* iii. p. 84; *DC. l. c.*

Variat α foliis glabris.—S. Russelianum, *Nees.*

Variat β foliis subsericeis.—S. subsericeum, *Nees, l. c.*

Hab. In locis glareosis montanis Nilgiri et Zeylaniæ, ad alt. 7800 ped., prope Ootacamund, *T. Anders.*; in montibus Dindygal, *Wight*!; Maisor et Carnatic, *G. Thomson*!; in Zeylania, *Thwaites, C. P.* 2001!

Wight's figures in the 'Icones,' t. 873, t. 1502, belong to this species. Nees quotes Wall. No. 183 in Herb. DC. as from Nepal; but there is no specimen of this genus from the Himalaya in the Wallichian Herbarium, or among the large collection of *Acanthaceæ* in the Kew Herbarium, or in the Herbarium of the Calcutta Botanical Gardens. The genus is confined to southern India and Ceylon.

4. S. SETOSUM, *T. Anders.*—Caule erecto, tetragono; foliis ovato-crenatis, apice longe acuminatis, asperis; spicis gracilibus; bracteis linearibus, calyces æquantibus, setoso-ciliatis, glandulosis; calycis segmentis ad medium coalitis; corolla infundibuliformi, tubo constricto elongato apice curvato; staminibus fertilibus longe exsertis; capsula glabra, compressa.—Strobilanthes no. 67, *herb. Ind. Or. Hook. fil. et T. Thoms.*

Hab. In provinciis Maisor et Carnatic, *G. Thomson*!

Planta suffruticosa, venosa. *Caulis* gracilis, tetragonus, supra nodos tumidus. *Folia* petiolata, basi oblique subcordata, valde venosa, 1–2 unc. longa, ½–1 unc. lata; petiolo tetragono, 1–2 unc. longo. *Flores* in ramis brevibus terminales. *Bracteæ* et calyces 3 lin. longi. *Corolla* calyce duplo longior. *Capsula* calycem æquans.

5. S. PARVIFLORUM, *T. Anders.* Foliis inferioribus et caulinis longissime petiolatis, ovatis, in petiolo decurrentibus, apice acuminatis, dentatis, glabris, foliis floralibus et ramorum plus minus sessilibus; spicis laxis, parvis, lanceolatis vel subulatis, calycem æquantibus, glabris; calycis segmentis subulatis, corolla multo brevioribus.—Stenosiphonium Russellianum, *N. ab E. l. c. partim.*—Ruellia arcuata, *Wall. Cat.* n. 2334 A, B.—Strobilanthes, sp. no. 68, *Herb. Ind. Orient. Hook. fil. et T. Thoms.*

Hab. In montibus Dindygal, *Wight in herb. Wall.* n. 2334!; in Maisor et Carnatic, *Herb. Hook. fil. et T. Thoms.*!, *Cleghorn*!

Herba ceteris speciebus minor. *Folia* acuminata, basi obliqua, in petiolo decurrentia, grosse dentata, 1–2 unc. longa, 1–1½ unc. lata, petiolo foliis sæpe duplo longiore. *Bracteæ* 2–3 lin. longæ. *Corolla* infundibuliformis, tubo gracili 4 lin. longo. *Stamina* 4, 2 exserta.

I possess several specimens of this species. It is easily distinguished by the smallness of all the parts of the inflorescence, but especially of the corolla.

XVI. Strobilanthes, *Blume.*

Sect. I. Endopogon. *Flores spicati. Spicæ elongatæ, plus minus terminales axillaresque, plerumque erectæ sed nunquam omnino axillares. Bracteæ imbricatæ.*

1. S. consanguineus, *T. Anders. in Thwaites's Enum. Pl. Zeyl.* p. 226, *cum syn.*

Variat α foliis glabris.—S. hypoleucus, *T. Anders. l. c.*

Variat β foliis hypoleucis.

Hab. In montibus Indiæ australis et Zeylaniæ; in montibus Nilgiri ad portam "Coonoor" dictam, *Beddome*!; in montibus Dindigul et Maisor, *Wight in herb. Wall.* 2408 a, b, c; in montibus Concan, *Gibson*!; Zeylaniæ, in provincia Maturatte, alt. 3000 ped., *Thwaites, C. P.* 2002! *partim*, 2897! var. hypoleucus.

2. S. nigrescens, *T. Anders. l. c.*

Hab. In Zeylania in provincia Ambagamowa, alt. 3000 ped., *Thwaites, C. P.* 3353!

3. S. viscosus, *T. Anders. l. c. cum syn.*—Endopogon versicolor, *Wight, Icon.* t. 1497, *excl. descriptione.*

Hab. In montibus Anamallay, *Beddome*, n. 69!; in provincia centrali Zeylaniæ, *Thwaites, C. P.* 2002 *partim*! et 2898!

4. S. cuspidatus, *T. Anders.*—Endopogon cuspidatus, *Benth. in Linnea,* xxiv. p. 646.—E. versicolor, *Wight, Icon. quoad descriptionem iconis,* t. 1497 (*excl. icone*).

Hab. In montibus Nilgiri, *Wight*!, *Hohenacker.*

I have seen the specimen, in Wight's herbarium, from which the figure no. 1497 of the 'Icones' was taken. The specimen belongs to *Strobilanthes viscosus*; but the description refers to *S. cuspidatus.*

5. S. Kunthianus, *T. Anders.*—Phlebophyllum Kunthianum, *N. ab E. in Wall. Pl. As. rar.* iii. p. 75 et 83, *cum syn.*

Hab. In pratis montanis Indiæ australis; in montibus Nilgiri, *Wight*!, *G. Thomson*!; ad Ootacamund, alt. 7000 ped., *T. Anders.*; in montibus Pulney, *Wight*!; prope Cochin, *Johnstone*!

Strobilanthes apricus, from Hongkong (see synonymy in Bentham's 'Flora Hongkongensis'), is nearly allied to this species.

6. S. RHAMNIFOLIUS, *T. Anders. l. c. cum syn.*

Hab. In provincia Hantani insulæ Zeylaniæ, ad alt. 4000 ped., *Thwaites, C. P.* 2007.

7. S. GARDNERIANUS, *T. Anders. l. c. cum syn.*

Hab. In Zeylania in provincia Hantani, ad alt. 4000 ped., *C. P.* 2006!

8. S. GOSSYPINUS, *T. Anders.* Caule erecto, tetragono, velutino; foliis petiolatis, ovatis, acuminatis, integerrimis, superne glabris, subtus gossypino tomentosis; petiolo tetragono, dense tomentoso; spicis axillaribus et terminalibus, bracteis tomento mollissimo obtectis; corolla extus pubescente, infundibuliformi, intus glabra, tubo brevi.

Hab. In montibus Mysore, *Lobb! in herb. Hook.*

Suffrutex tomento gossypino flavo omnino obtectus (foliorum facie superiore excepta). *Folia* $4\frac{1}{2}$ unc. longa, 2 unc. lata. *Spicæ* 3 unc. longæ. *Corolla* $1\frac{1}{2}$ unc. longa.

This is a most beautiful and distinct species, and is evidently rare, as it occurs only in Lobb's collection.

9. S. VESTITUS, *N. ab E. in DC. Prodr.* xi. p. 180.

Hab. In Zeylania ad Maturatte, alt. 5000–7000 ped., *C. P.* 3660!

10. S. ARNOTTIANUS, *N. ab E. l. c.* p. 179.

Hab. In Zeylania ad Newera Ellia, *Gardner, C. P.* 2005!

11. S. WIGHTIANUS, *N. ab E. l. c.* p. 180.

Hab. In montibus Nilgiri, *Schmid! in herb. Hort. Botan. Calc., Wight!, Beddome!*; ad Ootacamund, alt. 7500 ped., *T. Anders.*

12. S. ASPER, *Wight, Icon.* t. 1518.

Hab. In montibus Nilgiri, *Wight!*; montibus Anamallay, ad alt. 5000 ped., *Beddome!*.

13. S. PERROTTETIANUS, *N. ab E. in DC. l. c.* p. 179.

Hab. In montibus Nilgiri prope Ootacamund, *Wight!, Gardner!, Hohenacker!*; in provincia Maisor, *Lobb!*; Mayupuram, *F. Adam!*

Sect. 2. EUSTROBILANTHES. *Flores in spicis densis abbreviatis strobiliformibus aggregati, bracteis imbricatis.*

14. S. ERIOCEPHALUS, *Benth. in Flora,* xxxii. p. 557.

Hab. In montibus provinciæ Concan, alt. 1500 ped., *Law!, Stocks!*; in Canara, *Hohenacker,* n. 756; Maisor, *Law!*

15. S. ANCEPS, *N. ab E. in DC. l. c.* p. 189. *T. Anders. in Thwaites's Enum. Pl. Zeyl.* p. 229, *cum syn.*

Hab. In provincia centrali Zeylaniæ, ad alt. 2000–6000 ped., *Thwaites, C. P.* 2000!; in montibus Anamally, *Beddome!*

16. S. ADENOPHORUS, *N. ab E. l. c.* p. 182.—S. lanceolatus, *N. ab E. l. c.* p. 181.—Goldfussia Myrtinia, *N. ab E. l. c.* p. 174.—Stenosiphonium Moonianum, *Wight et Gardner.* — Myrtinia lanceolata, *Macrae,* n. 373 *in herb. Benth.*

Hab. In Zeylania, *Thwaites, C. P.* 162, *Macrae in herb. Benth.*

17. S. SCABER, *N. ab E. in Wall. Pl. As. rar.* iii. p. 84, *excl.* var. γ; *et DC. l. c.* p. 177, *excl.* var. β.—Ruellia aspera, *N. ab E. l. c.* p. 147. —Ruellia flava, *Roxb. Fl. Ind.* iii. p.43.—Ruellia (14), *herb. Ind. Or. Hook. fil. et T. Thomson.*

Hab. In Assam, *Jenkins*!; Silhet, *Wall. Cat.* 2393!; in montibus Khasiæ, *Griffith*!; Chittagong, *Hook. fil. et T. Thomson*!; in collibus Prome, *Wall. Cat.* 2393 c!; in provincia Pegu, *Brandis*!; in Zeylania, *Walker*! *in herb. Hook.* In Horto Botanico Calc. culta.

Distr. In insula Timor, *fide N. ab E. in DC. l. c.* p. 147.

I have not seen the specimens from Timor on which M. Decaisne's species *Strobilanthes aspera* is founded. I doubt if they can be referred to *Strobilanthes*, as Professor Decaisne says that the capsule is six-seeded, but *Strobolanthes* has only four seeds. *Strobilanthes aspera*, Dcne., is probably a species of *Hemigraphis*, a genus that has many representatives in the Philippine Islands and the eastern portion of the archipelago.

18. S. ROSEUS, *N. ab E. in Wall. l. c.* p. 84, *et DC. l. c.* p. 177.—Ruellia rosea, *Wall. Cat.* 7154.

Hab. In montibus Taong Dong, *Wall. Cat.* 7154!

19. S. CRISPUS, *Blume, Bijdr.* p. 798; *N. ab E. in DC. l. c.* p. 178.

Hab. Ad Rangoon, *Cleghorn*!; prope Moulmein in provincia Tenasserim, *Falconer*, n. 414!, *Parish*, n. 91!

Dist. Java!

20. S. GLAUCESCENS, *N. ab E. in Wall. Pl. As. rar.* iii. p. 85, *et DC. l. c.* p. 178, *cum syn.*

Hab. In regno Birmannico ad Prome in locis montosis, *Wall. Cat.* 7155!; in provincia Tenasserim, *Helfer*, 483!; in Pegu, *Brandis*!

21. S. SESSILOIDES, *R. Wight, Icon.* t. 1512.

Hab. In montibus Nilgiri, *Wight*!; in pascuis siccis prope Neddiwattam, alt. 6000 ped., *T. Anders.*; in montibus provinciæ Concan, *Gibson*!

22. S. SESSILIS, *N. ab E. DC. l. c.* p. 85.

Hab. In montibus Nilgiri ad Ootacamund, *Wight*!, *Foulkes*!; ad Neddiwattam, alt. 5500–7000 ped., *T. Anders.*; ad Takut, *Stocks*!

23. S. ZENKERIANUS, *T. Anders.*—Goldfussia Zenkeriana, *N. ab E. l. c.* p. 172.—Endopogon Strobilanthes, *Wight, Icon.* t. 1500.

Hab. In montibus Nilgiri, *Wight*!, *Beddome*!

24. S. FOLIOSUS, *T. Anders.*

Variat α omnino glaber.—Endopogon foliosus, *R. Wight, Icon.* t. 1501.

Variat β bracteis calyceque glanduloso-pilosis.—E. capitatus, *R. Wight*! *Icon.* t. 1499.

Hab. Var. α in montibus provinciarum Concan et Malabar, *Stocks*!, *Law*! ; β in montibus Nilgiri, *Wight*!

25. S. TETRAPTERUS, *Dalz. in Journ. of Bot.* ii. p. 342.

Hab. In montibus provinciæ Concan, *Dalzell*!, *Law*!, *Stocks*!

26. S. BARBATUS, *N. ab E. in Wall. Pl. As. rar.* iii. p. 85, *et DC. l. c.* p. 179.—Ruellia ciliata, *Wall. Cat.* 2392.

Hab. In montibus Courtallum, *Wall. Cat. ex herb. Madras*, n. 2392!

This species, of which merely a fragment exists in the Calcutta Herbarium, differs from *S. tetrapterus*, Dalz., only in the absence of winged angles to the stems. It is quite distinct from *Ruellia ciliata*, Wall. Cat. n. 2415.

27. S. CILIATUS, *N. ab E. l. c.* p. 85, *et DC. l. c.* p. 183.—S. Warreensis, *Dalz. in Journ. of Bot.* ii. p. 341.—Ruellia ciliata, *Wall. Cat.* n. 2415.—G. Zenkeriana, *Wight, Icon.* 1517, *quoad descript.*

Hab. In montibus Malabar et Concan, *Wight*, n. 1949!, *Stocks*!, *Law*!, *Dalzell*!; ad Cochin, *Johnstone*!

In the letterpress of Wight's Icones Plant. Ind. Orient. 1517, this species is referred to *Goldfussia Zenkeriana*, N. ab E. Wight says that, on naming the plate, he considered the plant to be identical with *S. ciliatus*, N. ab E. His plate, 1517, is most certainly Nees's *S. ciliatus*, although the figure is bad; while, as I have shown, No. 1500 of the 'Icones' is Nees von Esenbeck's *G. Zenkeriana* (*S. Zenkerianus*, T. Anders.).

28. S. PAPILLOSUS, *T. Anders.* *Caule* subtetragono pilis setosis patentibus hirsuto; *foliis* longe petiolatis, ovatis, basi in petiolum paulo decurrentibus, apice acuminatis, margine dentato-serratis, supra setoso-scaberrimis, papillisque obtectis, subtus pallidioribus, pilis setosis ad nervos hirsutis; *petiolis* subtetragonis, setoso-asperis; *spicis* terminalibus axillaribusque, pedunculatis, brevibus, foliosis, bracteatis; *bracteis* herbaceis, lanceolatis, margine setis albis dense ciliatis; *bracteolis* linearibus ciliatis; *calycis* segmentis longissime linearibus, hirsutis, margine ciliatis; *corolla* mediocris glabra, tubo gracili limbo infundibuliformi, lobis ovatis, æqualibus.

Hab. In montibus Nilgiri prope Ootocamund, *Hohenacker*, n. 1431!; Maisor, *Lobb*! *in herb. Hook.*; in collibus Bababoodun, *Law*!

Planta suffruticosa? hispida. *Folia* interdum basi inæquilatera cum petiolo 4–8 unc. longa, 2–4 unc. lata; nervis supra (in sicco) subglabris, subtus hispidissimis; petiolo sæpe $2\frac{1}{2}$ unc. longo. *Bracteæ* bracteolæ et segmenta calycis inter se fere æquilonga, omnino hispida, marginibus ciliata, $\frac{1}{2}$ unc. longa. *Corolla* 1 unc. longa, cærulea?.

29. S. MICRANTHUS, *Wight, Icon.* t. 1519.

Hab. In montibus Nilgiri, *Gardner in herb. Hook.*!, *Wight*!; in montibus Anamallay, *Beddome*!

30. S. LAXUS, *T. Anders. in Thwaites's Enum. Pl. Zeyl.* p. 228.
Hab. In Zeylania ad Hantani, alt. 4000 ped., *Thwaites, C. P.* 2010!

31. S. LURIDUS, *White, Icon.* t. 1515, 1516.
Hab. In sylvis montium Nilgiri ad Neddiwattam, *Wight*!; in montibus Anamallay ad alt. 6000 ped., *Beddome*!

32. S. LUPULINUS, *N. ab E. in Wall. Pl. As. rar.* iii. p. 85.—S. rugosus, *Wight, Ic.* t. 1619.—S. campanulatus, *Wight, Ic.* t. 1562.—S. Heyneanus, *N. ab E. in Wall. Pl. As. rar.* iii. p. 85.—S. asperrimus, *N. ab E. in DC. l. c.* p. 183.—S. tener, *N. ab E. l. c.* p. 184.—S. trifidus, *N. ab E. l. c.* p. 185.
Hab. In montibus Canara, *Gibson*!; Maisor et Malabar, *Stocks*!, *Law*!; in montibus Nilgiri et Anamallay, *Wight*!, *Beddome*!; in montibus Zeylaniæ ad alt. 6000 ped., *Thwaites, C. P.* 254! et 2008!

33. S. CALYCINUS, *N. ab E. l. c.* p. 186.—S. coloratus, *N. ab E. l. c.*
Var. β floribus stramineis.
Hab. In Zeylania in locis montanis ad alt. 7000 ped., *C. P.* 309!

34. S. HOOKERI, *N. ab E. l. c.* p. 185.
Hab. In montibus provinciæ centralis Zeylaniæ ad alt. 7000 ped., *Thwaites, C. P.* 1999!, *G. Thomson*!

35. S. ANDERSONI, *Beddome in Tr. Linn. Soc.* xxv. p. 222.
Hab. In montibus Anamallay, *Beddome*!

36. S. GRAHAMIANUS, *Wight, Icon.* t. 1520.
Hab. In montibus provinciarum Malabar, Maisor et Concan, *Graham*!, *G. Thomson*!, *Stocks*!, *Law*! n. 32, *herb. Ind. orient. H. fil. et T. T.*

37. S. CALLOSUS, *N. ab E. in Wall. Pl. As. rar.* iii. p. 85, *partim, et DC. l. c.* p. 185, *partim, cum varietatibus.*—Ruellia callosa, *Wall. Cat.* 2359.
Hab. In montibus Concan, *Stocks*!, *Law*!; in collibus "Daldallee" dictis provinciæ "Mundla," *Beddome*!, *cult. in Horto Botanico Calcuttensi* e Nagpur, *Wall. Cat.* 2359!; Strobilanthes, No. 69, *Orient. Hook. fil. et T. Thoms.*!

Nees von Esenbeck describes two varieties of this species, α. *glaber* and β. *hirtus.* The examination of a considerable number of specimens convinces me that the species varies much in the amount of pubescence as well as in the parts on which the pubescence occurs. Some specimens are quite glabrous; others are glabrous except the bracts, which are covered with viscid hairs; in other specimens, only the upper surface of the leaves is hairy. I find it impossible to define the limits of these variations.

38. S. ZEYLANICUS, *T. Anders. in Thwaites's Enum. Pl. Zeyl.* p. 227, *cum syn.*
Hab. In insula Zeylania ad Ambagamowa et Kokorl Corle, *C. P.* 3352!

39. S. WALKERI, *N. ab E. in DC. l. c.* p. 181.
Hab. In provincia centrali insulæ Zeylaniæ, *Thwaites, C. P.* 2008, 2009 *partim*! et 3517!

40. S. THWAITESII, *T. Anders. in Thwaites's Enum. Pl. Zeyl.* p. 227.
Hab. Insulam Zeylaniam in provincia Ambagamowa dicta, *Thwaites, C. P.* 2009 *partim*! et 3516!

41. S. DEFLEXUS, *T. Anders. in Thwaites's Enum. Pl. Zeyl.* p. 227.
Hab. In Zeylania, ad Hantani, alt. 4000 ped., *Thwaites, C. P.* 1998!

42. S. TRISTIS, *Wight, Icon.* t. 1508.
Hab. In montibus Nilgiri ad Sisparah, alt. 4000 ped., *Wight*!

43. S. CAUDATUS, *T. Anders. in Thwaites's Enum. Pl. Zeyl.* p. 227.
Hab. In Zeylania ad Hantani, alt. 2000–3000 ped., *Thwaites, C. P.* 364!

44. S. PALLIDUS, *T. Anders.*—Goldfussia decurrens, *Wight, Icon.* t. 1522; *non* Endopogon decurrens, *N. ab E., DC. Prodr.* xi. p. 105.
Hab. In montibus Nilgiri, *Wight*!

This species is a truly South-Indian one. Its bracts are decurrent along the peduncle, like those of *S. decurrens* (*Endopogon decurrens*, N. ab E.); and this resemblance probably led Wight to consider the Nilgiri plant to be the same as the Khasia species. *S. pallidus* belongs to the group of which *S. tristis* may be taken as the type. It is evidently a rare plant, as I have seen specimens of it only in Wight's latest collections recently presented to the herbarium of the Royal Gardens, Kew.

Sect. III. AMENTIANTHES. *Flores spicati; spicis sublaxis, elongatis, flaccidis* (*excl.* S. acrocephalo) *; bracteis subimbricatis.*

45. S. DECURRENS, *T. Anders.*—Endopogon decurrens, *N. ab E. in DC. l. c.* p. 105.
Hab. In montibus Khasiæ, alt. 1000–3000 ped., *Griffith*!, *Hook. fil. et T. Thoms.*!, *Oldham*!; Assam, *Griffith*!

46. S. FIMBRIATUS, *N. ab E. in Wall. Pl. As. rar.* iii. p. 85, *cum syn., et in DC. l. c.* p. 104.—Endopogon macrostegius, *N. ab E. in DC. l. c.* p. 104.
Hab. In montibus Khasiæ, *Wall. Cat.* 2363!, *Griffith*, n. 1141!, *Hook. fil. et T. Thoms.*!

47. S. POLYTHRIX, *T. Anders.*—Caule verrucoso, hirsuto; foliis ovatis, margine subintegris, pilis rufis utrinque hirsutis; spicis axillaribus, elongatis; bracteis subulatis, longissime caudatis, extus setose hirsutis,

bracteolis bracteis minoribus; calycis segmentis uninerviis, apice ciliatis; capsula apice sparse hirsuta.

Hab. In montibus Khasiæ, *in herb. Hort. Bot. Calcutt.*!

Planta pilis rufis subsericeis patentibus omnino obtecta. *Folia* longe petiolata, 4–7 unc. longa, 2 unc. lata; petiolo tenui, ciliato. *Spicæ* indivisæ, 2–4 unc. longæ. *Bracteæ* $1\frac{1}{2}$ unc. longæ, $1\frac{1}{2}$ lin. latæ. *Calyx* 8 lin. longus, capsulam vix superans. *Corollam* non vidi.

48. S. REMOTUS, *T. Anders.* Foliis ovatis acuminatis, margine subintegris, utrinque glabris; spicis axillaribus, solitariis vel binis, elongatis; floribus remotis, solitariis; bracteolis et calycis segmentis bracteis minoribus; capsula elongata, glabra.

Hab. In provincia Tenasserim, *Helfer*!

Caulis subteres, glaber. *Spicæ* $1\frac{1}{2}$–3 unc. longæ. *Bracteæ* lanceolatæ, mucronatæ, uninerviæ, glaberrimæ, 3 lin. longæ. *Bracteolæ* et *segmenta* calycis bracteis angustiores, 5 lin. longæ. *Capsula* 8 lin. longa.

This species I only know from a very imperfect specimen collected by Helfer in the Tenasserim provinces. It seems to be allied to the two preceding species. The specimen is too imperfect to be described in detail or to be distinguished by a good diagnosis.

49. S. KHASYANUS, *T. Anders.*—Endopogon Khasyanus, *N. ab E. in DC. l. c.* p. 104.

Hab. In montibus Khasiæ, ad alt. 3000–4000 ped., *Hook. fil. et T. Thoms.*!

50. S. HAPLANTHOIDES, *T. Anders.* Caule herbaceo, erecto; foliis petiolatis, ovatis, utrinque acuminatis, margine crenatis vel undulatis, utrinque glabris, floralibus ciliatis; spicis suberectis, subterminalibus, vix axillaribus, laxis; bracteis, bracteolis calycisque segmentis linearibus, setis hyalinis patentibus hirsutis et ciliatis; bracteis calycis segmentis longioribus; corolla infundibuliformi, extus pubescente, intus hirsuta, tubo abrupte constricto, limbi laciniis parvis; capsula basi constricta, supra ovata acuta, glabra, calycem paulo superante.

Hab. In Burmah ad Moulmein, *Falconer*, n. 402, *in herb. Hort. Bot. Calcutt.*; *Helfer*, n. 255!

Planta herbacea, 1–$1\frac{1}{2}$-pedalis. *Caulis* teres, glaber, ad nodos tumidus, sparse foliosus. *Folia* breviter petiolata, supra viridia, subtus pallida, 2–$3\frac{1}{2}$ unc. longa, 1–$1\frac{1}{2}$ unc. lata; petiolo 8 lin. longo. *Spicæ* laxæ, in apice caulis et in axillis foliorum superiorum confertæ, 2–3 unc. longæ. *Pedunculus* communis gracilis, hirsutus. *Bracteæ* oppositæ, $\frac{1}{2}$ unc. longæ, bracteolis et calyce duplo longiores. *Corolla* 8 lin. longa, purpurea? *Capsula* 5 lin. longa.

51. S. PERFOLIATUS, *T. Anders.*—Leptacanthus alatus, *Wight, Icon.* t. 1527.

Hab. In montibus provinciarum Concan et Coorg, *Stocks* !, *Law* !, *Gibson* !, *Dalzell* !

52. S. Helferi, *T. Anders.* Caule divaricate-ramoso, incano, pubescente, tereti; foliis caulinis petiolatis, ovatis vel cordatis, apice acuminatis, basi inæqualibus, margine undulato-crenatis, utrinque subglabris vel subtus ad nervos hirsutis; foliis floralibus sessilibus vel subsessilibus, cordatis, margine crenatis; spicis axillaribus patentibus vel reflexis, laxis, pubescentibus; floribus distantibus; bracteis oppositis, spathulatis, reflexis, pubescentibus, margine longe ciliatis; calyce brevi, segmentis linearibus pubescentibus, sparse ciliatis; corolla parva, tubo brevissimo, limbo subgloboso, laciniis parvis rotundatis; staminibus inclusis.

Hab. In Tenasserim ad locum "Tres Pagodas" dictum, *Helfer*, n. 495!

Planta divaricata. *Folia* 2–4 unc. longa, 1½–2 unc. lata. *Spicæ* graciles, incanæ, pubescentes, 3–6 unc. longæ. *Corolla* 5 lin. longa, intus barbata.

53. S. auriculatus, *N. ab E. in Wall. Pl. As. rar.* iii. p. 86, t. 195; *DC. l. c.* p. 191.—S. amplectens, *N. ab E. in Wall. Pl. As. rar. l. c.*—S. plumulosus, *N. ab E. l. c.*—S. Edgeworthianus, *N. ab E. in DC. l. c.* p. 190.

Hab. In locis montanis tropicis Indiæ orientalis in jugo Himalaico a Bhotan usque ad Deyra Dhun, *Wall. Cat.* 2341 !, *Royle* !, *Jacquemont*, n. 3468 !; in provincia Behar, *Vicary* !; in monte Parasnath, ad alt. 2000–4000 ped., *Edgeworth* !, *Hooker fil.* !, *T. Thoms.* !, *T. Anders.* !; in India centrali ad Jubbulpore, *Beddome* !; in montibus Khasiæ, 1000–5000 ped., *Griffith*, n. 1347 !, *Hook. fil. et T. Thoms.* !, *Simons*, 253 !; Burmah, in collibus Prome, *Wall. Cat.* 7157 !, ad Taong Dong, *Wall. Cat.* 7158 !; in montibus Karen, *Mason* !; Pegu, *Brandis* ! Cult. in Hort. Bot. Calcutt., *Wall. Cat.* 2341 !

54. S. Sabinianus, *N. ab E. in Wall. Pl. As. rar. l. c. cum syn., et DC. l. c.* p. 190.

Hab. In Nipalia, *Wall. Cat.* 2339 !; in montibus Khasiæ, ad alt. 4000 ped., *Griffith* !, *Hook. fil. et T. Thoms.* !, *Wall. Cat.* 2338 !

55. S. rufescens, *T. Anders.*—Ruellia rufescens, *Roth, Nov. Pl. Sp.* p. 304.—Buteræa ulmifolia, *N. ab E. Wall. Pl. As. rar.* iii. p. 84, *cum syn., et DC. l. c.* p. 196.

Hab. In Burmah ad Pegu in rupibus aridis, *Brandis* !; ad Moulmein, *Falconer*, 398 !, 401 !, 421 !, 424 !; in provincia Tenasserim, *Helfer* ! Olim cultus in Hort. Bot. Calcutt., *Wall. Cat.* 2360 !

56. S. Brunonianus, *N. ab E. in Wall. Pl. As. rar. l. c.* p. 87, *cum syn.*; *DC. l. c.* p. 188.

Hab. In montibus Khasiæ, ad alt. 3000–4000 ped., *Wall. Cat.* 2368 !, *Griffith* !, *Hook, fil. et T. Thoms.* !, *Simons* !; in collibus Jynteah, *Wall. Cat.* 2368; in Assam, *Jenkins* !

57. S. MACULATUS, *N. ab E., DC. l. c.* p. 190, *cum syn.*—S. monadelphus, *N. ab E., Wall. Pl. As. rar. l. c.* p. 87, *et DC. l. c.* p. 188.—S. petiolaris, *N. ab E., DC. l. c.* p. 189.

Hab. In montibus Khasiæ, ad alt. 3000–4000 ped., *Wall. Cat.* 7159!, *Griffith*!, *Hook. fil. et T. Thoms.*!; in Bhotan, *Griffith*, n. 2403!; Sikkim in sylvis umbrosis, ad alt. 3000 ped., *T. Thoms.*! *et T. Anders.*!

Wallich mentions a plant of this species which flowered in the Botanic Gardens, Calcutta, in 1816, and from which the drawing in the 'Plantæ Asiaticæ Rariores,' tab. 250 was made. This species, though it is still cultivated in the garden, seems never to have flowered again. I saw it abundantly in flower in a hot subtropical valley near Darjeeling in October 1863.

All the plants of this species at Darjeeling have leaves beautifully marked on the upper surface with regular lines of white blotches, as in the plant cultivated in the Botanic Gardens, Calcutta. This marking is very faint, and almost disappears in the dried specimens. I think I can trace the colouring on the leaves of all the specimens referred by Nees von Esenbeck to *S. monadelphus* aud *S. petiolaris.*

58. S. IMBRICATUS, *N. ab E., Wall. Pl. As. rar.* iii. p. 86, *excl. syn.* Strob. hirti, var. *β, Bl., et in DC. Prod.* xi. p. 186; *Wall. Cat.* 7156, *in herb. Hort. Bot. Cal.*

Hab. In montibus Taong Dong ad Pingee, *Wall. Cat.* 7156!; in provincia Tenassarim, *Helfer*, n. 496!

59. S. ACROCEPHALUS, *T. Anders.*—Caulibus numerosis, subtetragonis, setose hirsutis; foliis breviter petiolatis, ovatis acutis, margine serratis, utrinque setoso-hispidis; spicis plerumque terminalibus, pedunculatis, densis, glandulosis; bracteis breviter spathulatis, glandulosis, ciliatis, apice reflexis, 5-nerviis; bracteolis oblongis, obtusis, glandulosis, uninerviis; calycis segmentis linearibus, obtusis, uninerviis, apice glandulosis; corolla obliqua, glabriuscula, tubo elongato, limbo infundibuliformi; staminibus exsertis, didynamis; capsula parva, ovata, extus pubescente.

Hab. In montibus Khasiæ, *Griffith*!, *Oldham*! *Hook. fil. et T. Thoms.*, n. 63!, *Simons*!

Planta herbacea, 1½-pedalis. *Caules* juniores valde tetragoni, sulcati, pilis patentibus plus minus obtecti. *Folia* subtus pallida, ad nervos petiolosque hirsuta; petiolo 3–5 lin. longo. *Spicæ* cylindricæ, 1–2 unc. longæ, pedunculo 1–3 unc. longo. *Corollæ* cito deciduæ, cæruleæ?

60. S. ACUMINATUS, *T. Anders.*—Adenacanthus acuminatus, *N. ab E.*

in Wall. Pl. As. rar. iii. p. 84, *et DC. l. c.* p. 197 (*excl. syn.*—Ruellia Sabiniana, Lodd. Bot. Cab. t. 1712).

Hab. In Burmah, *Wall. Cat.* 7153!; in provincia Tenasserim, *Helfer*, n. 304!, *Kew Distr.* n. 6114.

The figure of *Strobolanthes Sabinianus* in the 'Botanical Cabinet,' and which Nees von Esenbeck, in the 'Prodromus,' refers to this species, is a very good representation of *S. Sabinianus*. It is difficult to understand why Nees von Esenbeck considered the above plate a figure of *S. acuminatus*. *S. acuminatus* is a rare plant; specimens of it occur only in a few sets of the Wallichian Herbarium, and one or two specimens have been collected by Helfer. It is nowhere in cultivation.

61. S. PECTINATUS, *T. Anders.*—Ruellia pectinata, *Wall. Cat.* 2356.—S. echinatus, *N. ab E. in Wall. Pl. As. rar.* iii. p. 85; *DC. l. c.* p. 181.

Hab. In montibus Khasiæ, *Wall. Cat.* 2356!, *Griffith*!; in montibus Himalayæ Sikkimensis prope Darjeeling in sylvis temperatis Querci et Castaneæ, ad alt. 5000–7000 ped., *T. Thoms.*!, *T. Anders.*!

62. S. SIMONSII, *T. Anders.*—Caule fruticoso, tomentoso; foliis petiolatis, lanceolatis, obliquis, basi acutis, apice acuminatis, margine serratis, supra hispidulis, ad nervos pubescentibus, subtus pallidis, tomentosis, petiolo pubescente; capitulis plerumque axillaribus, pedunculatis, solitariis, binis vel ternatis, abbreviatis, tomentosis; bracteis communibus 2, foliosis, lanceolatis, basi integris, apice dentatis, utrinque tomentosis; bracteolis lineari-lanceolatis, acutis, uninerviis, integris, utrinque pubescentibus, apice ciliatis; calyce profunde 5-partito, segmentis linearibus acutis, æqualibus, uninerviis, extus pubescentibus; corolla infundibuliformi, elongata, fere recta, glabra; capsula elongata, sublineari, glabra, tetrasperma.

Hab. In Assam ad Kamroop, *Griffith*, n. 249!; in collibus "Dewangiri" dictis, *Simons*!

Planta fruticosa, habitu *S. pectinati*. *Folia* $3\frac{1}{2}$–$6\frac{1}{2}$ unc. longa, 1–2 unc. lata. *Bracteæ* $1\frac{1}{2}$–2 unc. longæ, bracteolas et calycem longe superantes. *Corolla* fere 2 unc. longa. *Alabastrum* luteum (*fide Griffith*).

63. S. GLABRATUS, *N. ab E. in Wall. Pl. As. rar.* iii. p. 85, *cum syn.*, *et DC. l. c.* p. 183.

Hab. In montibus Khasiæ, *Wall. Cat.* 2390!, *Griffith*!, *Simons*!

64. S. GRACILIS, *T. Anders.*—Caule suffruticoso, erecto, gracili, tetragono, glabro; foliis breviter petiolatis, lanceolatis, apice caudatis, margine serratis, utrinque glabris, subtus pallidis, floralibus in pedunculo sessilibus; capitulis axillaribus, in pedunculo gracili simplici solitariis, vel in cymulis paucifloris dispositis; bracteis glumaceis, lanceolatis acutis, basi cucullatis, glabris, uninerviis, bracteolis bracteis omnino similibus; calycis segmentis brevibus, subulatis, uno longiore,

extus glandulosis, intus glabris; corolla elongata, infundibuliformi, tubo sursum curvato.

Hab. In montibus Khasiæ, *Griffith*!; in umbrosis provinciæ Mishmi, *Herb. Griffith, Kew Distr.* n. 6116!

Planta suffruticosa. *Caulis* adscendens, gracilis, foliosus, glaber. *Folia* oblique lanceolata acuta, serrata, breviter petiolata, 4–6 unc. longa, 1½–2 unc. lata; floralia parva, sessilia, 4–6 lin. longa. *Pedunculus* geniculatus, deflexus. *Bracteæ* et *bracteolæ* glumaceæ, glaberrimæ, 4–9 lin. longæ. *Calyx* 2½ lin. longus. *Corolla* 1½ unc. longa, tubo purpureo-venoso, limbo cæruleo-purpureo (*fide Griffith*).

65. S. NUTANS, *T. Anders.*—Goldfussia nutans, *N. ab E. in Wall. Pl. As. rar.* iii. p. 88, *et DC. l. c.* p. 174.—R. strobilina, *Wall. Cat.* 2362.

Hab. In montibus Nepal, *Wall. Cat.* 2362!

Sect. 4. GOLDFUSSIA. *Flores spicati, spicis per anthesin nudis, bracteis cito deciduis.*

66. S. GLOMERATUS, *T. Anders.*—Goldfussia glomerata, *N. ab E. in Wall. Pl. As. rar.* iii. p. 88, *et DC. l. c.* p. 173.—Ruellia glomerata, *Wall. Cat.* 2361.

Hab. In sylvis montanis Khasianis, *Wall. Cat.* 2361!, *Griffith*!, *Hook. fil. et T. Thoms.*!, *Oldham*!; in montibus Burmannicis "Taipo" dictis, ad alt. 3000 ped., atque prope fluvium Salwen, *Brandis*!

67. S. CAPITATUS, *T. Anders.*—Goldfussia capitata, *N. ab E. in Wall. Pl. As. rar.* iii. p. 88, *et DC. l. c.* p. 173, *cum syn.*

Hab. In sylvis umbrosis tropicis Himalayæ, Nepal, *Wall. Cat.* 2351!; Sikkim, ad alt. 1500–6000 ped., *T. Thoms.*!, *T. Anders.*; Bhotan, *Griffith*!; Assam, *Masters*!, *Simons*!; in montibus Burmannicis "Karen" dictis, *Mason*!

68. S. BRANDISII, *T. Anders.*—Caule debili, subherbaceo, pilis glandulosis patentibus, incano pubescente; foliis longe petiolatis, lanceolatis vel ovato-lanceolatis, apice acuminatis, basi in petiolo decurrentibus, margine serratis, supra glabriusculis, subtus incano tomentosis; floribus in capitulis brevibus terminalibus axillaribusque congestis; bracteis spathulatis, utrinque pubescentibus, subtus incanis; bracteolis linearibus, dense tomentosis; calycis segmentis linearibus, albido tomentosis, ciliatis; corolla curvato-infundibuliformi, glabra, limbi lobis parvis rotundatis; staminibus brevibus, inclusis, glabris; capsula subovata, apice pubescente.

Hab. In sylvis montanis sempervirentibus "Tongoo" regni Burmah, ad alt. 4000 ped., *Brandis*!

Planta debilis, pubescentia incana. *Caulis* subtetragonus, pubescens, ad nodos tumidos longe ciliatus. *Folia* valde petiolata, 3–6 unc. longa, ½–1½ unc. lata. *Capitula* pedunculata; pedunculus ½ unc. longus. *Bracteæ* variæ, semper spathulatæ, 5–8 lin. longæ. *Corolla* calycis

segmentis quadruplo longior, glaberrima, $1\frac{1}{2}$ unc. longa, purpurea? *Capsula* tetrasperma, 4–5 lin. longa. *Semina* ovata; testa ciliata.

69. S. BICEPS, *T. Anders.*—Goldfussia biceps, *N. ab E. in Wall. Pl. As. rar.* iii. p. 88, *cum syn., et DC. l. c.* p. 172.
Hab. In Burmah ad Taongdong, *Wall. Cat.* 7161!

70. S. LAMIIFOLIUS, *T. Anders.*—Goldfussia lamiifolia, *N. ab E. in Wall. Pl. As. rar.* iii. p. 88, *cum syn., et DC. l. c.* p. 171.
Hab. In montibus Himalayæ, ad Nepal, *Wall. Cat.* 2347!; in Sikkim, *Griffith*!; in montibus Khasiæ, *Goldfussia*, n. 26, *in herb. Hook. fil. et T. Thoms.*! In horto botanico Calcuttensi culta.

71. S. COLLINUS, *N. ab E. in Wall. Pl. As. rar.* iii. p. 86, *cum syn., et DC. l. c.* p. 192.
Hab. In locis collinis insulæ Penang, *Wall. Cat.* 2343!

72. S. GLUTINOSUS, *N. ab E. in Wall. Pl. As. rar.* iii. p. 86, *cum syn., et DC. l. c.* p. 194.
Hab. In montibus Himalayæ a Nepal usque ad Hasora in gradu lat. bor. 35; Nepal, *Wall. Cat.* 2350!; in Hasora, *Stewart*!

73. S. ALATUS, *N. ab E. in DC. l. c.* p. 194.—Ruellia urticifolia, *Wall. Cat.* n. 2346.
Hab. In sylvis montanis regionis temperatæ Himalayæ; in Nepal, *Wall. Cat.* 2346!; Sikkim in valle fluvii Runjeet, ad alt. 5000 ped., *T. Anders.*; in Gharwal ad Kunjoor, alt. 6500 ped., *T. Anders.*; ad Simla, *T. Anders., T. Thoms.*!; in Kashmir ad Ruttun Pir, *Stewart*!

74. S. EXTENSUS, *N. ab E. in DC. l. c.* p. 195.—Goldfussia extensa, *N. ab E. in Wall. Pl. As. rar.* iii. p. 88.
Hab. In montibus Khasiæ, ad alt. 4000 ped., *Wall. Cat.* 7160!, *Hook. fil. et T. Thoms.*!, *Griffith*!, *Oldham*!, *Simons*!

75. S. INFLATUS, *T. Anders.*—Caule tereti, pubescente; foliis petiolatis, lanceolatis, acutis, margine serratis, utrinque molliter pubescentibus; floribus plerumque solitariis, sessilibus, rarissime terminalibus, subpaniculatis; bracteis foliosis, spathulatis, pubescentibus; bracteolis 2, minutis, subulatis; calyce æqualiter 5-partito, segmentis linearibus, uninerviis, pubescentibus; corolla valde curvata, pubescente, in alabastro incano-tomentosa, tubo brevissimo, limbo magno, inflato, lobis brevibus, rotundatis; capsula elongata, apice mucronata, glabra.
Hab. In Sikkim, ad alt. 5000–8000 ped., *Hook. fil. et T. Thoms.* n. 28!

Planta, caulibus veteribus exceptis, pubescentia fusca obtecta. *Folia* in specimine manco 1–2 unc. longa, 5–8 lin. lata. *Bracteolæ* minutæ, ad basin calycis adpressæ, 1–2 lin. longæ. *Calyx* post anthesin accrescens, per anthesin 4 lin. longus, post anthesin 6–7 lin. longus, capsulam æquans. *Corolla* extus pubescens, calyce triplo longior, staminibus inclusis.

76. S. ATROPURPUREUS, *N. ab E. in Wall. Pl. As. rar.* iii. p. 86, *et DC. l. c.* p. 195.—Ruellia atropurpurea, *Wall. Cat.* n. 2398.
Hab. In sylvis temperatis montium Himalayæ, ad alt. 6000 ped.; in Nepal, *Wall. Cat.*, 2398!; Kunawur, *Vicary*!; Laka, *Edgeworth*!; Kumaon, *T. Anders.*!

77. S. WALLICHII, *N. ab E. in Wall. Pl. As. rar.* iii. p. 87, *et DC. l. c.* p. 193, *cum syn.*—Goldfussia Thomsoni, *Hook. in Bot. Mag.* t. 5119.
Hab. In montibus Himalayæ a Sikkim usque ad flumen Chenab: in Sikkim, ad alt. 6000–10,000 ped., *Hook. fil. et T. Thoms.*!, *T. Anders.* n. 1043!, 1044!, 1045!, 1048, 1058!, 1071!; in Nepal, *Wall. Cat.* 2371 A!; in monte Mahassoo prope Simla, *Edgeworth*!; Kishtwar et Jamu, *T. Thomson*!

78. S. UROPHYLLUS, *N. ab E. in DC. l. c.* p. 192, *cum syn.*
Hab. In montibus Khasiæ ad Pundooah, *Wall. Cat.* 2344!; in Sikkim, inter Kursiong et Mahalderam, ad alt. 5500 ped., *T. Anders.*; in montibus Himalayæ orientalis, *herb. Griffith, Kew Distr.* n. 6125!

79. S. PENTSTEMONOIDES, *T. Anders.*—Ruellia pentstemonoides, *Wall. Cat.* 2340.—R. cephalotes, *Wall. Cat.* 2352.—Goldfussia pentstemonoides, *N. ab E. in Wall. Pl. As. rar.* iii. p. 88, *et DC. l. c.* p. 175.—G. Dalhousiana, *N. ab E. in DC. l. c.* p. 174.
Hab. In montibus Himalayæ temperatis, vulgaris ab alt. 5000 ped. usque ad 10,000: Sikkim, *Hook. fil. et T. Thoms.*, *T. Anders.* n. 1037, 1038, 1052, 1060; Nepal, *Wall. Cat.* 2340!, 2352!; Kumaon et Ghurwal, *Strach. et Winter.*!, *T. Anders.*; Simla, *Griffith*!, *T. Anders.*; ad Dharmsala, *Edgeworth*!

80. S. CRATÆGIFOLIUS, *T. Anders.*—Caule erecto, diffuso, glabro, juniore tetragono; foliis sessilibus, ovatis, spathulatis, margine crenatis, supra lineolatis, subtus glabris, pallidis; floribus in pseudo-capitulis laxis, pedunculatis, axillaribus, capitulis 3–5-floris, deflexis, sericeis; bracteis herbaceis, lanceolatis, margine ciliatis, extus glandulosis, hirsutis; bracteolis calyci conformibus, linearibus, ciliatis, calyce profunde et inæqualiter 5-partito, segmentis linearibus, margine ciliatis; corolla infundibuliformi, recta, tubo brevi, angusto, limbo amplo, lobis magnis, rotundatis, patentibus; staminibus inclusis.
Hab. In provincia Tenasserim prope Moulmein in sylvis montanis, *Parish*, 413!
Caulis glaber. *Folia* herbacea, apice acuta, 1½–2 unc. longa, 8 lin. lata. *Capitula* laxa, in pedunculis foliosis axillaribus terminalia; folia floralia parva, rotunda. *Bracteæ* parvæ, inconspicuæ. *Corolla* integra, glabra, 1 unc. longa.

81. S. DISCOLOR, *T. Anders.*—Goldfussia discolor, *N. ab E. in DC. l. c.* p. 172.
Hab. In montibus Himalayæ ad Bhotan, *Griffith*, 2399!; in valle Assamica, *Wallich*!, *Griffith*!, *MacClelland*!, *Masters*!, *Jenkins*!; in

collibus "Naga" dictis, *Masters*!, *Simons*!; ad ripas fluminis "Dikho" dicti, *Masters*!; in montibus Khasiæ, *Griffith, Kew Dist.* 6120!, *Simons*!, *Hook. fil. et T. Thoms.*!

82. S. ISOPHYLLUS, *T. Anders. in Cat. Pl. Hort. Bot. Calcutt.* p. 43. —Goldfussia isophylla, *N. ab E. in Wall. Pl. As. rar.* iii. p. 88, *et DC. l. c.* p. 176.

Hab. In Assam, *Griffith*!; Sylhet, *Wallich*! In horto botanico Calc. cultus, et inde in omnes hortos botanicos tropicos introductus.

83. S. ANISOPHYLLUS. *T. Anders. in Cat. Pl. Hort. Bot. Calc.* p. 43. —Ruellia anisophylla, *Hook. Exot. Fl.* t. 191. — Goldfussia anisophylla, *N. ab E. in Wall. Pl. As. rar.* iii. p. 88, *et DC. l. c.* p. 176. —Ruellia persicifolia, *Griff. Posth. Papers*, vol. ii. p. 70, n. 1089.

Hab. In montibus Khasiæ, *Wall. Cat.* 2349!, *Griffith herb. propr.* 1089!, *Hook. fil. et T. Thoms.*!, *Simons*!; in collibus "Rooprai" et "Dewangaree" dictis, *Simons*!

84. S. THOMSONI, *T. Anders.*—Suffruticosus, glaber; caule gracili, sulcato; foliis petiolatis, inæqualiter ovatis, basi in petiolo decurrentibus, apice longe acuminatis, margine acute serratis, supra glabris, subtus pallidis; spicis axillaribus, simplicibus vel ramosis, laxis, foliis brevioribus vel interdum longioribus; floribus sessilibus, solitariis, oppositis; bracteis minutis, spathulatis; bracteolis linearibus, bracteis paulo longioribus; calycis segmentis linearibus, acutis, glabris vel viscosis, uno cæteris longiore, post anthesin accrescentibus; corolla infundibuliformi, curvata, extus pubescente, limbi lobis parvis; capsula ovato-lanceolata, mucronata, pubescente.

β. serratifolius. Robustior, foliis longissime acuminatis, acute serratis, valde nervosis; spicis elongatis, ramosis.

Hab. In vallibus humidis interioribus Sikkim, ad alt. 2000–6000 ped., *Hook. fil. et T. Thoms. Goldfussia*, no. 30!, *T. Anders. herb. Sikkim.* n. 1037!, 1041!, 1042!, 1048!, 1049!, 1050!

Var. *β* ad ripas fluminum Kulhait et Rumaum *T. Thoms.*!, *T. Anders.*

Sect. 5. SECUNDIFLORI. *Flores spicati; spicis secundis, paucifloris; bracteis minutis.*

85. S. DIVARICATUS, *T. Anders.*—Ruellia divaricata, *Wall. Cat.* 2372. —Goldfussia divaricata, *N. ab E. in Wall. Pl. As. rar.* iii. p. 89, *et DC. l. c.* p. 176.

Hab. In sylvis umbrosis temperatis Himalayæ, ad alt. 6000–10,000 ped.; in Nepal, *Wall. Cat.* 2372!; in Sikkim, *Hook. fil. et T. Thoms.*!, *T. Anders. herb. Sikkim.* 1033!, 1034!, 1035!, 1036!; in montibus Khasiæ, ad alt. 5000–6000 ped., *Hook. fil. et T. Thoms.*! *Simons*, 482!, *in herb. Hort. Bot. Calc.*

86. S. PANICHANGA, *T. Anders.*—Ruellia Panichanga, *Wall. Cat.* 2387.—Asystasia Panichanga, *N. ab E. in DC. l. c.* p. 167.

Hab. In montibus Khasiæ prope Silhet, *Wall. Cat.* 2387 B!

87. S. BOËRHAAVIOIDES, *T. Anders.*—Planta laxa; caule debili, tereti, glabro; foliis caulinis longe petiolatis, ovatis, acuminatis, basi in petiolo decurrentibus, margine obtuse serratis, supra viridibus, plerumque glaberrimis, subtus glaucis; floralibus sessilibus, cordatis, apice acutis; floribus remotis, in spicis axillaribus elongatis paucifloris, seu in paniculis terminalibus; bracteis parvis, late obovatis obtusis, extus sparse glandulosis; bracteolis et bracteis æqualibus, linearibus, subacutis; calycis segmentis late linearibus, uninerviis, extus glandulosis, bracteolis quadruplo longioribus, post anthesin accrescentibus; corolla fere recta, glabra, tubo brevi, limbo elongato inflato, lobis æqualibus parvis rotundatis; staminibus inclusis, filamentis ligulatis glabris; capsula lanceolata acuta, glabra, tetrasperma, seminibus magnis.

Hab. In montibus Khasiæ, ad alt. 4000–5000 ped., *Hook. fil. et T. Thoms., Goldfussia*, n. 27!, *Simons*!; in locis subtropicis montium Himalayæ ad Sikkim, alt. 5000 ped., *T. Thoms.*!

Folia inferiora petiolata, 4–8 unc. longa, $1\frac{1}{2}$–3 unc. lata. *Spicæ* longitudine variæ, plerumque 3–4 unc. longæ. *Flores* in pedunculo sessiles. *Bracteæ* 2 lin. latæ. *Calyx* $2\frac{1}{2}$ lin. longus, demum 6 lin. longus. *Corolla* cærulea, 1 unc. longa. *Capsula* 7 lin. longa, glabra vel subglandulosa.

88. S. RUBESCENS, *T. Anders.*—Caule erecto, ramoso, versus basin tereti, superne subtetragono, glabro, interdum hirsuto; foliis variis, inferioribus brevibus, petiolatis, lanceolatis, utrinque acute acuminatis, margine serratis et subspinuloso-ciliatis, utrinque aspero-hirsutis, rubescentibus; foliis caulinis et superioribus sessilibus, basi cordatis, apice acutis, margine undulatis, utrinque glaberrimis, rarius supra hirsutis, in sicco supra atris subtus rubescentibus; spicis glabris, axillaribus, solitariis, paucifloris, vel terminalibus, subpaniculatis; floribus parvis, remotis, subsecundis; bracteis ovatis, obovatis vel rotundis; bracteolis minutis, ovatis; calycis segmentis æqualibus, lineari-lanceolatis, uninerviis, glabris vel extus glandulosis, accrescentibus; corolla ampla, tubo dilatato, paulo incurvo, lobis valde divisis; capsula ovato-lanceolata, acuta, glabra.—Goldfussia, 309, *Griff. Posth. Papers*, vol. ii. p. 20.

Hab. In montibus Khasiæ, *Griffith, herb. propr.* 309, *Kew Distr.* 6108.

Planta erecta rubescens. *Folia* crassa, in sicco margine revoluta, inferiora 3–5 unc. longa; caulina parva, decussata. *Spicæ* patentes, paucifloræ, adscendentes, 4–6 unc. longæ. *Flores* abortu solitarii, secundi, sessiles. *Bracteæ* duæ, oppositæ, una parva vacua. *Calyx* bracteis et bracteolis duplo longior, fere ad medium divisus. *Corolla* $1\frac{1}{2}$ unc. longa, cærulea (*fide Griffith*).

89. S. HELICTUS, *T. Anders.*—Caule erecto, tetragono, sulcato, glabro; foliis petiolatis, ovato-lanceolatis, basi in petiolo decurrentibus, apice acuminatis, margine acute serratis, rarissime subintegris, supra

glabris, subtus pallidis et molliter tomentosis, valde nervosis; spicis axillaribus, simplicibus vel dichotomis, elongatis, filiformibus, geniculatis, flexuosis, paucifloris; bracteis linearibus, elongatis, oppositis, una florifera, altera vacua breviore; bracteolis parvis subulatis; floribus breviter pedunculatis, abortu solitariis, alternis; calycis segmentis magnis, linearibus acutis, uno paulo breviore, glabris, rarius glandulosis; corolla ampla, inflata, glabra, tubo brevi, limbo curvato, inflato, ad lobos constricto, lobis æqualibus, rotundatis, patentibus, apice emarginatis; capsula lanceolata, acuta, glabra, calyce breviore, tetraspermo.—Echinacanthus calycinus, *N. ab E. in DC. l. c.* p. 168.—Asystasia calycina, *N. ab E. in Wall. Pl. As. rar.* iii. p. 90.

Hab. In sylvis temperatis montanis Assam et Khasiæ, *herb. Griffith., Kew Distr.* n. 6121!; Sikkim in vallibus temperatis interioribus, *T. Thoms.*!; in quercetis et sylvis laurineis ad cœnobium Sikkimmense "Doobdi" dictum, ad alt. 5500 ped., *T. Anders.*

Planta amabilis, 1–2-pedalis. *Caulis* adscendens, glaber. *Folia* in planta Assamica sparse hirsuta, 3–6 unc. longa, 1–2 unc. lata. *Spicæ* 4–8 unc. longæ, plerumque adscendentes. *Calyx* profunde divisus, 8 lin.–1 unc. longus. *Corolla* pulcherrima, conspicua, lacteo-alba, 1½–2 unc. longa; tubo calyce occulto.

90. S. SECUNDUS, *T. Anders.*—Caule tetragono, sulcato, glabro; foliis petiolatis, ovato-lanceolatis, rarius lanceolatis, utrinque acutis, apice acuminatis, margine plerumque serratis, interdum undulatis, utrinque glabris; spicis simplicibus, terminalibus, rarius axillaribus, erectis (pendulis, *fide Griffith*), paucifloris; floribus remotis, solitariis, oppositis, declinatis; bracteis bracteolisque deciduis: calyce profunde diviso, segmentis elongatis, linearibus, glabris, superiore cæteris longiore; corolla infundibuliformi, curvata, tubo brevi, lobis parvis rotundatis erectis, alabastro extus tomentoso; staminibus inclusis.

Hab. In Assam, *Masters*, 99! et 341!, *Simons*, no. 23 *in herb. Kew.*!, *Jenkins*!; in montibus Mishmi, *Griffith*!

Suffrutex 4–5-pedalis. *Folia* sparsa, viridia, subtus glabra, purpureo-sanguinea, magnitudine variabilia, 2–9 unc. longa, 1–4 unc. lata. *Spicæ* 6–12 unc. longæ. *Flores* sessiles, ebracteati. *Corolla* lutea, tubo purpureo-fusca.

Sect. 6. PANICULATI. *Flores paniculati; bracteis et bracteolis herbaceis, calyce minoribus; calycis segmentis æqualibus.*

91. S. LANCEIFOLIUS, *T. Anders.*—Caule fruticuloso, tereti, cortice incano minute furfuraceo; foliis petiolatis, lanceolatis, apice acuminatis, margine crenatis, utrinque glabris vel subtus lineolatis, paniculis terminalibus, dichotomis, glandulosis, tomentosis; floribus solitariis, oppositis; bracteis subulatis, calyce dimidio brevioribus; bracteis bracteolis paulo longioribus, linearibus; calycis segmentis herbaceis, linearibus, tomentosis; corolla elongata, anguste infundibuliformi, recta, lobis ovato-rotundatis.

Hab. In provincia Tenasserim, *Parish*, 402!

Fruticulus pallidus. *Folia* utrinque acuminata, subtus fere incana, 4–8 unc. longa, 1–2 unc. lata; petiolo 1 unc. longo. *Paniculæ* 6-unciales vel longiores, molliter pubescentes, pilis glandulosis patentibus aspersis. *Calyx* 6 lin. longus, segmentis æqualibus pubescentibus. *Corolla* extus pubescens, 1½–1¾ unc. longa, portione infundibuliformi gradatim in tubum transeunte.

92. S. FLACCIDIFOLIUS, *N. ab E. in DC. l. c.* 194.—S. Championi, *T. Anders. in Benth. Flora Hongkong.* p. 261, *cum syn.*

Hab. In montibus provinciæ Assam, *Masters*!, *Jenkins*, 1387!; in montibus Khasiæ, *Simons*!; in collibus provinciæ Mishmi, *Griffith*! In montibus interioribus Burmah, propter succum infectorium cultus.

Distr. China!, Hongkong!

This is the plant that yields the blue dye called by the Assamese "Room." Although the plant is indigenous, it is said to be cultivated by the Assamese near their dwellings. It is also cultivated by the tribes in the Mishmi hills. Dr. Brandis, Conservator of Forests, has sent me specimens of this plant from the Karen hills, where it is cultivated for the dye obtained from it. I also possess a specimen from Mr. Fortune, who says of it, "a plant largely cultivated in the province of Chekeang (China) for the blue dye it produces." An examination of a very extensive suite of specimens from Eastern Bengal and Burmah, as well as of Mr. Fortune's Chinese plant, and of additional specimens sent to me by Dr. Hance, of Whampoa, enables me to identify my *S. Championi* with Nees von Esenbeck's plant.

93. S. GRIFFITHIANUS, *T. Anders.*—Triænanthus Griffithianus, *N. ab E. in D. C. l. c.* p, 169.

Hab. In montibus Khasiæ, alt. 3000 ped., *Griffith*!, *Hook. fil. et T. Thoms.*!

94. S. COLORATUS, *T. Anders.*—Goldfussia colorata, *N. ab E. in Wall. Pl. As. rar.* iii. p. 89, *et DC. l. c.* p. 176, *cum syn.*

Hab. In montibus vallis Assamicæ, *Griffith*, 2402!, *Masters*!, *Simons*!, *Jenkins*!; in montibus Khasiæ, *Hook. fil. et T. Thoms.* In horto botanico Calcutt. cultus.

95. S. CRINITUS, *T. Anders.*—Goldfussia crinita, *N. ab E. in DC. l. c.* p. 176.

Hab. In Assam, *Griffith*, 1280!, *Masters*!, *Simons*!

Corolla alba fide Masters, cæruleo-purpurea fide Griffith.

96. S. MASTERSI, *T. Anders.*—Caule erecto, dichotome ramoso, tetragono, sulcato, glanduloso-viscoso; foliis superioribus subsessilibus, lanceolatis, acutis, margine serratis, subglabris; floribus paniculatis, laxis, viscosis; paniculis dichotome ramosis, erectis; pedi-

cellis elongatis, plerumque unifloris; bracteis lanceolatis acutis, sparse glandulosis, deciduis; calycis segmentis æqualibus, linearibus, extus glanduloso-viscosis; corolla infundibuliformi, suberecta, glabra, limbi lobis parvis, non patentibus; staminibus inclusis; capsula oblanceolata, elongata, ad apicem glandulosa, tetrasperma.

Hab. In Assam, *Masters*!, *Simons*!

I have seen of this species three very imperfect specimens, with a few detached leaves and the remains of one or two floral ones still adhering to the specimens. The lax elongated panicles of flowers distinguish this plant from *S. glandulosus*, to which, judging from the shape of the corolla and capsule, it appears to be very nearly allied.

Sect. 7. LEPTACANTHUS. *Flores laxe paniculati, bracteis plerumque deciduis; calycis segmentis inæqualibus, duobus longioribus; capsula magna, ovoidea.*

97. S. MICROCARPUS, *T. Anders.*—Caule inferne subtereti, supra nodos tumido, superne tetragono, sulcato; foliis petiolatis, ovatis, apice acuminatis, margine grosse serratis, utrinque hispidis, patentim venosis; paniculis axillaribus et terminalibus, ascendentibus, paucifloris, viscoso-glandulosis; floribus sessilibus, oppositis; bracteis ovatis, margine ciliatis, deciduis; bracteolis parvis, subulatis, glabris; calyce ultra medium quinque-partito, segmentis duobus cæteris longioribus, linearibus acutis, glanduloso-ciliatis; corolla infundibuliformi, glabra, tubo brevi, paulo curvato, limbo amplo; staminibus inclusis; capsula glabra, parte sterili lineari, fertili ovata mucronata.

Hab. Locus natalis incertus est, sed forsan provincia Tenasserim; in herbario Helferiano exemplum vidi.

Planta 1–2-pedalis, erecta. *Folia* basi inæqualia, hispida, herbacea, 4–8 unc. longa, 2–3½ unc. lata. *Paniculæ* caulinæ inferiores graciles, 1–2 unc. longæ, superiores 4–6 unc. longæ, ramosæ. *Calyx* 3–4 lin. longus. *Corolla* 9 lin. longa; tubo in limbum abrupte transeunte. *Capsula* calycem longitudine æquans.

98. S. BEDDOMEI, *T. Anders.*—Caule erecto, glabro, foliis sessilibus, lanceolatis, apice acuminatis, basi auriculatis, amplexicaulibus, margine serratis, utrinque glabris; paniculis ramosis; pedunculis et pedicellis glabris vel viscosis; floribus remotis, solitariis, oppositis; bracteis parvis, lanceolatis vel linearibus; bracteolis linearibus, bracteis longioribus; calyce fere ad basin quinque-partito, segmentis linearibus, glabris vel apice viscosis; corolla arcuata, tubo fere nullo; capsula ovoidea, glabra, apice acuta, mucronata.

Hab. In montibus Anamallay, *Beddome*!

Frutex 20–30-pedalis. *Folia* 3–8 unc. longa, 1½–2 unc. lata. *Paniculæ* terminales 6–10 unc. longæ. *Flores* subsessiles, erecti. *Calyx* seg-

mentis inæqualibus, 6 lin. longus. *Corolla* glabra, 1 unc. longa. *Stamina* inclusa. *Capsula* 8 lin. longa.

99. S. SEXENNIS, *N. ab E. in DC. l. c.* p. 187.—S. argutus, *N ab E. in DC. l. c.* p. 188.—S. cerinthoides, *N. ab E. in herb. Hook.*

Var. hirsutissimus, *T. Anders. in Thw. Enum. Pl. Zeyl.* p, 229.—S. hirsutissimus, *N. ab E. in DC. l. c.* p. 187.

Hab. In Zeylania prope Newera Ellia, *Walker, Thwaites, C. P.* 66!, 2593!, 2594!; var. *hirsutissimus, C. P.* 3626!

100. S. HELICOIDES, *T. Anders. in Thw. En. Pl. Zeyl.* p. 229.—Leptacanthus helicoides, *N. ab E. in DC. l. c.* p. 170.

Hab. In Zeylania ad provincias Hantani et Ambagamowa, ad alt. 3000 ped., *Thwaites, C. P.* 1980! *J. Watson! in herb. H. B. C.*

101. S. RUBICUNDUS, *T. Anders.*; *non* S. rubicundus, *T. Anders. in Thw. En. Pl. Zeyl.*—Leptacanthus rubicundus, *N. ab E. in Wall. Pl. As. rar.* iii. p. 90, et *DC. l. c.* p. 170.

Hab. Certissime in peninsula Indiæ orientalis, *Wight in herb. Wall.* 2337!

102. S. PULCHERRIMUS, *T. Anders. l. c.*—Leptacanthus Walkeri, *N. ab. E. in DC. l. c.* p. 170.

Hab. In montibus Nilgiri ad Neddiwattam, alt. 6000 ped., *Wight!*, *McIvor!*, *T. Anders.*; in provincia centrali Zeylaniæ, ad alt. 4–7000 ped., *C. P.* 266!, 301!

103. S. PANICULATUS, *T. Anders.* Caule erecto, tereti, glabro; foliis petiolatis, lanceolatis, longe acuminatis, margine subintegris, utrinque leviter tomentosis; paniculis terminalibus, elongatis, laxis, demum filiformibus, glanduloso-villosis; floribus oppositis vel subsecundis, bracteis oppositis, æqualibus, linearibus vel subulatis, glabris, bracteolis minutis, sæpissime ad papillas reductis; calyce subcampanulato, ad medium 5-partito, sparse glanduloso-villoso, laciniis subæqualibus; corolla subinfundibuliformi, glabra, limbi lobis parvis, erectis; staminibus inclusis; capsula ignota.—Strobilanthes rubicundus, *T. Anders. in En. Pl. Zeyl. excl. syn.*

Hab. In Zeylania in arvis Saffragam et Ambagamowa, *Thwaites, C. P.* 3351! in sylvis Wynaad, ad alt. 3000 ped., *Beddome!*

Planta 4–5-pedalis. *Folia* herbacea, 4–8 unc. longa, $\frac{3}{4}$–$1\frac{1}{2}$ unc. lata. *Paniculæ* laxæ, ramosæ, 1–$1\frac{1}{2}$ ped. longæ. *Pedicelli* breves, filiformes. *Bracteæ* longitudine variabiles, 4 lin.–1 unc. longæ. *Calyx* $2\frac{1}{2}$–3 lin. longus. *Corolla* violacea, 1 unc. longa.

Species incertæ sedis.

104. S. DENTICULATUS, *T. Anders.*—Ruellia denticulata, *Wall. Cat.* 2418.—Asystasia denticulata, *N. ab E. in Wall. Pl. As. rar.* iii. p. 89, et *DC. l. c.* p. 164.

Hab. Khasia, *Wall. Cat.* 2418!; in montibus Patkay Assam superioris, *Griffith!*

105. S. SPICATUS, *T. Anders.* Caule tetragono, sulcato, ramis adscendentibus; foliis subsessilibus, ovatis vel ovato-lanceolatis, acutis, basi subcordatis, margine acute serratis, supra tomentosis, subtus pallide pubescentibus; spicis in ramis terminalibus, elongatis; floribus sessilibus, solitariis, oppositis; bracteis foliosis, ovatis, pubescentibus; bracteolis parvis, herbaceis, spathulatis; calyce herbaceo, pubescente, segmentis linearibus, inæqualibus, uno cæteris longiore; corolla elongata, infundibuliformi, paulo curvata, glabra; capsula oblanceolata, apice glandulosa, tetrasperma, valvis naviculæformibus, seminibus magnis.

Hab. In montibus Khasiæ supra Nunklow, *Simons*!

Planta (corolla excepta) omnino molliter pubescens. *Folia* herbacea, 1–3 unc. longa, $\frac{1}{4}$–1 unc. lata; floralia in bracteas transeuntia. *Bracteæ* longitudine variabiles, 3–6 lin. longæ, utrinque pubescentes. *Bracteolæ* calyce dimidio breviores. *Calyx* 5 lin. longus. *Corolla* $1\frac{1}{4}$ unc. longa.

106. S. SALICIFOLIUS, *T. Anders.* Caule subtereti; foliis sessilibus, spathulate lanceolatis acutis, margine remote serratis; capitulis pedunculatis, brevibus, axillaribus, sparse hirsutis; bracteis parvis, ovatis, glabris; bracteolis lanceolatis, viscidis, hirsutis; calycis segmentis inæqualibus, lineari-lanceolatis, viscide hirsutis, uninerviis; corolla valde infundibuliformi, tubo constricto, recto; staminibus brevibus, inclusis.

Hab. Locus natalis ignotus est. Exemplum unicum adest in herbario meo proprio, Londini emptum.

Planta suffruticosa, glabra. *Caulis* subteres, ad nodos plerumque tetragonus. *Folia* sessilia, glabra, subtus pallida, fere glauca, 1–2 unc. longa, 3–6 lin. lata. *Pedunculus* folia æquans vel paulo brevior, bracteas 2 vel 4 vacuas gerens. *Flores* in capitulo 2–4. *Calyx* viscido-hirsutus, 6 lin. longus, 1 lin. latus. *Corolla* extus glabra, intus ad labium inferius hirsuta, lobis parvis, adscendentibus.

107. S. FALCONERI, *T. Anders.* Caule tetragono, longissime ciliato; foliis floralibus subsessilibus, ovatis, acutis, margine serratis, utrinque hirsutis; capitulis in ramis terminalibus, abbreviatis; floribus approximatis; bracteis herbaceis, ovatis, hirsutis; bracteolis linearibus, hirsutis, uninerviis; calyce profunde 5-partito, segmentis æqualibus, linearibus, utrinque hirsutis; corolla recta, extus paulo hirsuta, limbi lobis parvis, adscendentibus; staminibus inclusis; capsula apice tomentella, valvis naviculæformibus, retinaculis magnis, acutis; seminibus ovatis, hirsutis.

Hab. Ad Moulmein, *Falconer*, n. 423!

Planta setis sericeis patentibus hirsuta. *Caulis* ad angulos longissime ciliatus, omnino hirsutus. *Folia* caulina ignota; floralia $\frac{1}{2}$–2 unc. longa, 2–8 lin. lata. *Capitula* foliosa, pauciflora, hirsuta. *Bracteæ* ovatæ, interdum spathulatæ, utrinque hirsutæ, ad margines longissime ciliatæ. *Bracteolæ* 5 lin. longæ, calycis segmentis longiores. *Corolla* 8 lin. longa. Semina magna, hirsuta.

108. S. LAMIOIDES, *T. Anders.* Caule dichotome ramoso, subtetragono, glandulose tomentoso; foliis floralibus sessilibus, ovatis, acuminatis, margine obtuse serratis, supra glabris, subtus subtomentosis; capitulis terminalibus, paucifloris; bracteis spathulatis, extus glandulose tomentosis, intus subglabris, margine ciliatis; bracteolis linearibus acutis, subglabris; calyce ad medium 5-partito, segmentis linearibus acutis; corolla recta, utrinque tomentosa, alabastro incano tomentoso; staminibus inclusis; capsula magna, basi seminifera, apice sterili, valvis naviculæformibus, apice barbatis, retinaculis attenuatis, apice dentatis, seminibus magnis.

Hab. In jugo montium Birmannicorum "Taijoo" dicto, ad alt. 4000 ped., *Brandis*!; in montibus Nat-Toung, *Cross*!

Planta glandulosa. *Folia* caulina ignota; floralia magna, herbacea, 1–3 unc. longa, 1–2 unc. lata. *Capitula* foliosa, laxa, sessilia, sed interdum breviter pedunculata. *Corolla* ruelliæformis, tomento incano adpresso obtecta, 8 lin. longa. *Capsula* compressa, lata, ½ unc. longa.

109. S. VIOLÆFOLIUS, *T. Anders.* Caule herbaceo, tereti; foliis petiolatis, inferioribus rotundis, oblique ovatis acutis serratis, basi inæqualiter subcordatis, subglabris; spicis angulatis, paucifloris; floribus remotis, subsessilibus, solitariis, oppositis; bracteis linearibus; calycis segmentis linearibus, acutis, glabris; corolla infundibuliformi, recta, utrinque glabra, lobis æqualibus, parvis.

Hab. In convalle interiore Sikkimensi "Ratong" dicta, ad alt. 5000 ped., *T. Anders.*!

Planta debilis. *Partes* novellæ pubescentes. *Folia* petiolata; superiora subsessilia, 1½–3½ unc. longa, 1–1½ unc. lata; petiolo filiformi, 1 unc. longo. *Spicæ* ramos laterales terminantes, 3–4 unc. longæ. *Bracteæ* lineares, interdum spathulatæ, herbaceæ, 2–3 lin. longæ. *Bracteolæ* subulatæ, 1 lin. longæ. *Calyx* profunde divisus; segmentis æqualibus, 5 lin. longis. *Corolla* pallide cærulea, 8 lin. longa.

XVII. ÆCHMANTHERA, *N. ab E.*

1. Æ. WALLICHII, *N. ab E. in DC. l. c.* p. 170.

Var. α. tomentosa.—Æ. tomentosa, *N. ab E. in Wall. Pl. As. rar.* iii. p. 87.—Ruellia tomentosa, *Wall. Cat.* 2333.

Var. β. gossypina.—Ruellia gossypina, *N. ab E. in Wall. Pl. As. rar.* i. p. 38. t. 42.

Hab. Var. α in jugo montium Himalayæ a Simla usque ad Bhotan, ad alt. 3000–5000 ped., *Wall. Cat.* 2333 A, B!, *Royle*!, *Griffith*, 2408! et 6125!, *Hook. fil. et T. Thoms.*! β in Nipalia, *Wall. Cat.* 2332!; in Gharwal, *Royle*!; Sirmoor, *Vicary*!; Assam, *Simons*! Cult. in hort. bot. Calc.!

XVIII. DÆDALACANTHUS, *T. Anders.*

1. D. TUBIFLORUS, *T. Anders.* Caule subtetragono, glabro; foliis petiolatis, ovatis, acutis, a basi decurrentibus, margine minute undulatis, glabris; spicis terminalibus et axillaribus, pedunculatis; bracteis

magnis, late ovatis, acutis, cuspidatis, minute tomentellis; bracteolis parvis, subulatis, scariosis, uninerviis; calycis segmentis æqualibus, subulatis acutis, scariosis; corolla elongata, supra medium deflexa, tubo constricto, lobis parvis rotundis integris non patentibus; staminibus duobus, exsertis.

Hab. In Assam superiore ad ripas fluminis Burrampooter, *Lowther*!; in collibus Mishmi, *Griffith*!

Suffrutex floribus formosis insignis. *Caulis* robustus, subtetragonus. *Folia* supra sublineata, subtus pallida, 4–10 unc. longa, 2–3½ unc. lata. *Spicæ* ascendentes, axillares, solitariæ, cum pedunculo 3–6 unc. longæ. *Bracteæ* formosæ, albidæ, viridi venosæ, imbricatæ, decussatim oppositæ, ½–1 unc. longæ, 4–8 lin. latæ. *Bracteolæ* minutæ, calyci adpressæ, vix 2 lin. longæ. *Calyx* inconspicuus, bracteolis duplo longior, scariosus. *Corolla* 1 unc. longa, deflexa, glabra, variegata, tubo purpureo, portione infundibuliformi rubra. *Stamina* exserta, filamentis glabris.

2. D. SPLENDENS, *T. Anders.* Caule erecto, subtetragono, ad nodos tumido; foliis petiolatis, ovatis acutis, basi in petiolo decurrentibus, margine repandis, supra lineolatis, asperis, subtus hirsutis; spicis plerumque terminalibus, pedunculatis, elongatis, viscide tomentosis; bracteis pulcherrime venosis, magnis, late ovatis, breviter cuspidatis; bracteolis et calycibus parvis, scariosis, glabris; corolla infundibuliformi, supra medium curvata, extus pubescente, lobis ovatis acutis, reflexis, intus glabris; genitalibus longissime exsertis.—Eranthemum sp. 23, *herb. Hook. fil. et T. Thoms.*

Hab. In sylvis tropicis Himalayæ Sikkimensis alt. 1000–2000 ped., *Griffith*!, *Hook. fil. et T. Thoms.*!, *T. Anders.* Cult. in Hort. Bot. Calc!

Suffrutex paucifoliatus, omnino hirsutus. *Caulis* simplex; rami laterales fere nulli. *Folia* ovata, apice acuta, 5–10½ unc. longa, 2–4½ unc. lata. *Spicæ* terminales 3, rarissime 5; spica media 14 unc. longa, laterales 4–9 unc. longas superans. *Rachis* tetragona, tomentosa. *Bracteæ* inferiores vix imbricatæ, ovatæ, 1 unc. longæ, 6 lin. latæ. *Corolla* rosea, 1¼ unc. longa.

3. D. GRIFFITHII, *T. Anders.* Caule tereti, glabro, folioso; foliis breviter pedunculatis, lanceolatis, basi in petiolo decurrentibus, apice acuminatis, margine repandis, utrinque minute lineolatis; spicis terminalibus axillaribusque, pedunculatis, glabris, rachi acute tetragona; bracteis late ovatis, acuminatis, cuspidatis, reticulatim venosis; corolla infundibuliformi, infundibulo elongato, angusto, tubum æquante, lobis parvis, ovatis acutis, reflexis; genitalibus exsertis; capsula magna, compressa, basi sterili, portione seminifera ovata, apice mucronata.—Eranthemum, sp., *Griff. Itin. Notes*, ii. p. 96, n. 1437.

Hab. In Assam ad marginem sylvæ Ghoorgong, *Griffith*, n. 1437!; ad Gowhatty, *Simons*! *in herb. H. B. Calcutt.*

Suffrutex ramosus, 3–5-pedalis. *Folia* opposita, æqualia, 3–7 unc. longa, 1¼–2 unc. lata. *Spicæ* simplices, densæ, glabræ, 2–4 unc. longæ.

Bracteæ imbricatæ, apice cuspidatæ, paulo patentes, albidæ, pulcherrime et conspicue venis viridibus reticulatæ, ¾ unc.–1¼ unc. longæ. *Corolla* subglabra, anguste infundibuliformis, extus carnea, intus rosea (*fide Griff.*), 1¼ unc. longa, lobis parvis reflexis. Stamina breviter exserta.

4. D. NERVOSUS, *T. Anders.*—Justicia nervosa, *Vahl, En.* i. p. 164.—J. pulchella, *Roxb. Pl. Corom.* p. 41, t. 177.—Eranthemum nervosum, *R. Br. Prodr. Fl. Nov. Holl.* i. p. 476, et *N. ab E. in DC. Prodr.* xi. p. 445.—E. pulchellum, *Andr. Rept.* t. 88.—E. Edgeworthianum, *N. ab E. in DC. l. c.* p. 446.

Hab. In sylvis tropicis Himalayæ ab Assam usque ad Simla alt. 1000–2500 ped., Assam, *Griffith*!, *Jenkins*!, *Masters*!, *Simons*!; in Sikkim, *Hook. fil. et T. Thoms.*!, *T. Anders.*; Nipal, *Wall. Cat.* 2493!; in Himalaya bor. occid., *Griffith*!, *Royle*!; ad Deyrah Dhoon, *Vicary*!; *in hort. bot. Calcutt. cultus*!

Distr. In hortis botanicis Bogorensi, Kewensi, insulæ Trinitatis et Peradeniensi cultus.

5. D. SCABER, *T. Anders.*—Eranthemum nervosum, *R. Br. Prodr. Fl. Nov. Holl.* i. p. 474, et *N. ab E. in DC. l. c.* p. 446, var. *scabrum*.—E. scabrum, *Wall. in Icon. Biblioth. hort. Bot. Calcutt.*

Hab. In montibus Himalaya ad Nepal, *Wall. Cat.* 2493!; in Sikkim, *T. Thoms.*!; in Bhotan, *Griffith*!; in montibus Khasia prope Silhet, *Wall. Cat.* 2493!; Burmah ad Pingee, *Wall. Cat.* 7173!, *in hort. bot. Calcutt. cultus.*

6. D. MACROPHYLLUS, *T. Anders.*—Eranthemum macrophyllum, *Wall. Cat.* 7179; *N. ab E. in Wall. Pl. As. rar.* iii. p. 106, et *DC. l. c.* p. 446.

Hab. In montibus Burmannicis in rupibus ad Pingee in ripa Irrawaddi fluminis et in collibus Prome, *Wall. Cat.* 7179!; in sylvis collium Sitang, *Brandis*!; in montibus Karen, *Mason*!; ad Pegu, *MacClelland*!; in provincia Tenasserim et insulis Andaman, *herb. Helfer, Kew Distr.* no. 6128! *sub. nom* D. stricti, *T. Anders.*

7. D. STRICTUS, *T. Anders.*—Eranthemum strictum, *Colebr. in Roxb. Fl. Ind. or. ed. Wall.* i. p. 114; *N. ab E. in DC. l. c.* p. 448, *excl. syn.*

Hab. In montibus Khasiæ, *Wall. Cat.* 2494!; in Assam, *Simons*!; in Bengalia orientali ad Chittagong, *Hook. fil. et T. Thoms.*!; *in hort. bot. Calcutt. cultus*!

Nees is in error in quoting Wallich's number 2492 as belonging to this species. All the letters under 2492 belong to the Peninsular and Ceylon species, *Dædalacanthus montanus*.

8. D. ROSEUS, *T. Anders.*—Justicia rosea, *Vahl, En.* i. p. 165.—Eranthemum roseum, *R. Br. Prodr. Fl. Nov. Holl.* i. p. 477; *N. ab E. in DC. l. c.* p. 447.

Hab. In montibus provinciarum Concan et Malabar, *Stocks*!, *Law*!

9. D. TETRAGONUS, *T. Anders.*—Eranthemum tetragonum, *Wall. Cat.* 7180; *N. ab E. in Wall. Pl. As. rar.* iii. p. 106, et *DC. l. c.* p. 447.
Hab. In Burmah ad Trogla, *Wall. Cat.* 7180!; ad Moulmein, *Falconer*, n. 413!, *Parish*, n. 406!; ad Thoungyen, *Brandis*!
Distr. In montibus insulæ Javæ!

Nees von Esenbeck has described the colour of the corolla as "coccinea?" Parish says it is pale blue.

I hesitate to quote *Eranthemum salaccense*, Blume, as a synonym of this species. In the Calcutta Herbarium there are two specimens of *D. tetragonus*, from Tjipannas, on the base of the Volcano Gede, a mountain only a few miles distant from the Salak. The description of *E. salaccense* agrees well with *D. tetragonus*.

10. D. SUFFRUTICOSUS, *T. Anders.*—Eranthemum suffruticosum, *Roxb. Fl. Ind.* i. p. 111; *N. ab E. in Wall. Pl. As. rar.* iii. p. 107, et *DC. l. c.* p. 448, *cum syn.*
Hab. In insulis Andaman, *Roxburgh*!, *Haughton*!, *in hort. botan. Calcutt. cultus.*

Roxburgh, in the drawings in the Library of the Calcutta Botanical Gardens, united his *Eranthemum barlerioides* with this species, although in the 'Flora Indica' they are described as distinct species. They are apparently identical.

11. D. MICROSTACHYUS, *T. Anders.* Caule erecto, crasso, quadrangulari, angulis costatis; foliis subsessilibus, ovatis, apice acutis, basi in petiolum brevem decurrentibus vel subcordatis, paniculis terminalibus, trichotome divisis, ramulis dichotomis; floribus oppositis, remotis; bracteis parvis, longe distantibus, ovatis; calyce minuto; corolla hypocraterimorpha, tubo angusto, elongato, limbi lobis amplis, obliquis, oblongis, apice obtusis, patentibus; staminibus inclusis.
Hab. In provincia Tenasserim, *Parish*!, *in hort. bot. Calcutt. cultus*!
Planta herbacea, erecta, pubescens, vix 2-pedalis. *Caulis* rigidus, pubescens, supra nodos tumidus, inter nodos abbreviatus. *Folia* æqualia, magna, dependentia, caulem occultantia, utrinque pubescentia, 3–8 unc. longa, $2\frac{1}{2}$–$4\frac{1}{2}$ unc. lata. *Paniculæ* erectæ, rigidæ, glandulosæ, pubescentes, 4 unc. longæ. *Bracteæ* amplexicaules, nunquam imbricatæ, 2–4 lin. longæ. *Corolla* recta, glabra, purpurea, 1–$1\frac{1}{2}$ unc. longa; limbo fere 1 unc. lato.

12. D. PURPURASCENS, *T. Anders.*—Eranthemum purpurascens, *N. ab E. in DC. l. c.* p. 447.
Hab. In montibus Dindygul et Courtallum, *Wight*!; in collibus Bababoodun in provincia Malabar, *Law*!; in provincia Behar, *Hook. fil.*, in monte Parasnath a basi ad verticem, *T. Thoms.* et *T. Anders.*; Sumbulpore, *Griffith*!, *in hort. botan. Calcutt. cultus*!

13. D. MONTANUS, *T. Anders. in Thwaites's Enum. Pl. Zeyl.* p. 225.—Justicia montana, *Roxb. Pl. Corom.* vol. ii. t. 176, p. 41.—Eranthemum montanum, *Roxb. Fl. Ind.* vol. i. p. 110, *N. ab E. in Wall. Pl. As. rar.* iii. p. 107, *et DC. l. c.* p. 448.—E. Wightianum, *Wall. Cat.* 2495, *et N. ab E. in Wall. l. c. et DC. l. c.* p. 449.

Hab. In regionibus montanis peninsulæ Ind. orient.; Circars, *Roxburgh*!; Maisor et Carnatic, *G. Thomson in herb. Hook. fil. et T. Thoms.*!, *Law*!, *Cleghorn*!; in montibus provinciæ Concan, *Stocks*!, *Heyne in herb. Wall.* n. 2492! et 2495!, *ex herb. Wight*; in insula Zeylania, *Thwaites, C. P.* 2003!, *T. Thoms.*!; ad Moulmein, *Parish*!, *in hort. bot. Calc. cultus.*

14. D. PARISHII, *T. Anders.* Caule tetragono, glabro, nodis distantibus tumidis; foliis inferioribus longe petiolatis, superioribus subsessilibus, ovatis, acutis, basi in petiolum decurrentibus; floribus solitariis vel in spicis axillaribus paucifloris dichotome ramosis conglomeratis; bracteis minutis, subulatis; bracteolis magnis, trapeziformibus vel ellipticis, glabris, margine undulatis, calyce parvo, scarioso, segmentis æqualibus, subulatis, glabris; corolla tubo elongato, gracili, limbo hypocraterimorpho, profunde 5-fido, lobis late ovatis, obtusis, patentibus; staminibus occultis; capsula late compressa glabra.—Eranthemum Parishii, *T. Anders. in herb. Kew ex Parish*, n. 323.

Hab. In regno Birmannico ad Pegu, *Brandis*!; Suayghin, *Scott*!; Moulmein, *Parish*!

Planta erecta, glabra, paucifoliata. *Rami* pauci, tetragoni, inferiores interdum procumbentes. *Caulis* inferne teres, superne tetragonus, glaber. *Folia* utrinque acuta et glabra, margine undulata, in planta vivente subtus rubescentia, 3–5 unc. longa, 1–2 unc. lata. *Spicæ* laxæ, 2–5 unc. longæ. *Flores* decussati, remoti. *Bracteæ* minutæ. *Bracteolæ* magnæ, ovatæ vel trapeziformes, herbaceæ, uninerviæ, concolores, reticulatim venosæ. *Calyx* minutus, bracteolis obtectus. *Corolla* bracteolas superans, cærulea; tubo gracili, pubescente, 1½ unc. longo, limbo patente, ½ unc. lato. *Capsula* late compressa, tetrasperma, 1 unc. longa, bracteolis occulta.

When I referred this plant to *Eranthemum* (vide suprà) I had seen only imperfect specimens. Since then I have received living plants of it from the Rev. C. Parish, of Moulmein; they possess all the generic characters of *Dædalacanthus*.

XIX. BARLERIA, *Linn.*

1. B. BUXIFOLIA, *Linn. Sp. Pl.* p. 636; *N. ab E. in Wall. Pl. As. rar.* iii. p. 94, et *DC. Prodr.* xi. p. 241.

Hab. In locis aridis saxosis Indiæ australis; in montibus Courtallum, *Wight*!; in collibus "Bababoodun" dictis, *Law*!, *Gibson*!, *Heyne in Wall. Cat.* n. 2504! Cult. in hort bot. Calcutt.

2. B. Spina Ceylanica, *N. ab E. in DC. l. c.* p. 242.—B. bispinosa, *N. ab E. in Wall. Pl. As. rar.* iii. p. 94, *excl. syn., et DC. l. c.* p. 241, non B. bispinosa, *Vahl.*

Hab. In montibus siccis Indiæ et Zeylaniæ; in montibus Canara et Dharwar, *Law*!, *Gibson*!, *Wight*!; in Zeylania, *C. P.* 2013!

See a note under *B. bispinosa*, Vahl, in Journ. Proceed. Linn. Soc. vol. vii. p. 27.

3. B. acanthoides, *Vahl, Symb.* i. p. 47; *N. ab E. in DC. l. c.* p. 240.—B. triacantha, *Hochst., N. ab E. l. c.*—B. candida, *N. ab E. l. c.*—B. cranthemoides, *R. Br. in Salt's Abyss. Append.* iv. p. 64.

Hab. In Sind, *Stocks*!

Distr. In Muscat!, Arabia Felici!, Abyssinia!, Nubia!

4. B. noctifolia, *Linn. Suppl.* p. 290; *N. ab E. in DC. l. c.* p. 239.

Hab. In planitie Carnatic, *Heyne in herb. Wall.* n. 2496!, *Wight in herb. propr.*!; Sind, *Stocks*!

5. B. cuspidata, *Wall. Cat.* 2499; *N. ab E. in DC. l. c.* p. 239.

Hab. In aridis Maisor et Carnatic, *Wall. Cat.* 2499!; ad Palamcottah, *Wight in herb. propr.*!; ad Coimbatore et Mettapolliam, *T. Anders.*!; prope Bombay, *Gibson*!

6. B. Prionitis, *Linn. Sp. Pl.* p. 636; *N. ab E. in Wall. Pl. As. rar. l. c.* p. 93, *et DC. l. c.* p. 237.—B. hystrix, *Linn. Mant.* p. 89.—B. diacantha, *Hochst. et N. ab E. in DC. l. c.* p. 238.—B. brevispina, *R. Br. in Salt's Abyss. App.*—Prionitis Hystrix, *Miq. in Flor. Ind. Batav.* ii. p. 809.

Hab. Per totam Indiam et Zeylaniam aridam frequens; in Bengal, *Hook. fil. et T. Thoms.*!; Assam, *Masters*!, *Jenkins*!, *Griffith*!; Silhet, *Wall. Cat.* 2510!; ad Lucknow, *Anders.*!, *Bonavia*!; Saharunpore, *Royle*!; in provinciis Carnatic, Concan, Malabar et Maisor, *G. Thomson*!, *Stocks*!, *Law*!, *Cleghorn*!; in Zeylania, *C. P.* 2012!; Malacca, *Griffith*!, *in hort. bot. Calcutt. culta.*

Distr. In Java et insulis Philippinis pro sepibus frequentissime culta.

7. B. cristata, *Linn. Sp. Pl.* p. 636; *N. ab E. in Wall. l. c.* p. 92, *et DC.* p. 229.—B. dichotoma, *Roxb. Fl. Ind.* iii. p. 39.—B. ciliata, *Roxb. l. c.* p. 38.—B. laciniata, *N. ab E. in Wall. op. cit.* p. 91.—B. Napalensis, *N. ab E. l. c.*—B. nuda, *N. ab E. l. c.* p. 92.

Hab. In regionibus siccis Indiæ centralis et boreali-occidentalis: Sumbulpore, *Griffith*!; Behar ad basin montis Parasnath, *T. Thomson*!, *Anders.*!; Kumaon ad ripas fluminis Surjoo, *Anders.*!; Kashmir, *Stewart*!; Sirmoor, *Vicary*!; Bengal ad Berhampore, *Vicary*!; Assam, *Masters*!, *Jenkins*!; Silhet, *Wall. Cat.* n. 2508!; in convallibus tropicis interioribus Sikkim ad fluvium Kulhait, *T. Anders.*!; in Burmah ad Prome et Segain, *Wall. Cat.* n. 2508!; Taong Dong, *Wall. Cat.* n. 7144!; in montibus "Karen" dictis, *Riley*!; in pe-

ninsula Malayana, ad Penang et Malacca, *Wall. Cat.* 2508!, *Griffith*!; in insula Zeylania, sed certe non indigena, *C. P.* 228!
Distr. Java!, Hongkong!, Canton!, sed certissime ex hortis.

This species is extensively cultivated in tropical gardens; and in Java it, along with *B. Prionitis*, is used as a hedge-plant. It is undoubtedly a native of the tropical valleys of the Himalaya and the Khasia hills, of the hilly parts of Behar, and also of the Burmese mountains. I have seen it in Sikkim and Kumaon, also on Parasnath. In Sikkim and Kumaon it occurs in the deep valleys of the dry inner ranges, far away from cultivation, and nearly 100 miles from the plains. I do not think that it extends to the southern parts of India, or to the islands of the Malayan archipelago. The Hongkong specimen has probably escaped from a garden.

8. B. TOMENTOSA, *Roth. Nov. Sp. Pl.* p. 314; *N. ab E. in Wall. l. c.* p. 92, *et DC. l. c.* p. 233, *cum syn.*—B. acuminata, *Wight, Ic. Pl. Ind. orient.* t. 450; *N. ab E. in DC. l. c.* p. 234,
Hab. In collibus aridis provinciarum australium Indiæ, præsertim versus maris littora; ad Tanjore, *Wight*!; in montibus Bababoodun, *Law*!; in collibus Pulney, *Beddome*!; Maisor, *Cleghorn*!, *Wall. Cat.* 2503 A, *ex parte*, B!

9. B. LONGIFOLIA, *Linn. Suppl.* p. 290; *N. ab E. in Wall. l. c.* p. 93, *et DC. l. c.* p. 235.
Hab. In locis montanis provinciarum Malabar, Carnatic et Circars, *Roxburgh*!, *Wall. Cat.* n. 2501!, *Wight*!

10. B. PILOSA, *Wall. Cat.* 2502; *N. ab E. in Wall. l. c.* p. 93, *et DC. l. c.* p, 234.
Hab. In peninsula australi ad Courtallum, *Heyne in herb. Wall.* n. 2502!, *Wight*!

11. B. NITIDA, *N. ab E. in Wall. l. c.* p. 91, *et DC. l. c.* p. 224.
Hab. In provinciis Maisor et Carnatic, *G. Thomson*!, *Wight*!

12. B. POLYTRICHA, *Wall. Pl. As. rar.* i. p. 72, t. 82.—B. hirsuta. *N. ab E. in Wall. l. c.* iii. p. 91.
Hab. In Burmah ad ripas fluminis Irrawaddi, *Wall. Cat.* 7143!; in collibus ad Prome, *Wall. Cat.* 7142 A!; in provincia Martaban ad Moulmein, *Falconer*, n, 399!, *in herb. H. B. Calcutt.*; *Scott, hortul. ejusdem horti*, n. 175!; in provincia Tenasserim, *Helfer, Kew Dist.* n. 6135! In hort. bot. Calcutt. culta!

13. B. CÆRULEA, *Roxb. Pl. Ind.* iii. p. 39; *N. ab E. in Wall. l. c.* p. 91, *et DC. l. c.* p. 226, *cum variet.*
Hab. In locis montanis provinciarum Orissa, Behar, Sikkim, Assam, Malabar et Concan, *Wall. Cat.* 2509!, *Roxburgh*!, *Stocks*!, *Law*!,

Hook. fil. et T. Thoms. !, *Griffith* !, *Masters* !, *T. Anders.* ! ; *in hortis botanicis Calc. et Saharunpore culta* !

14. B. Lawii, *T. Anders.* Caule tereti, strigoso-pubescente ; foliis breviter petiolatis, ovatis, apice acutis, basi in petiolum subdecurrentibus, margine integris vel undulatis, supra lineolatis, subtus strigosis ; floribus terminalibus, subspicatis, rare solitariis seu binis ; bracteis bracteolisque conformibus, parvis, linearibus acutis, uninerviis ; calycis segmentis superiore et inferiore ovato-lanceolatis, coloratis, reticulatim venosis, superiore apice integro, 6–7-nervi, inferiore apice bifido, mutico, 5–6-nervi, segmentis lateralibus linearibus, caudatis ; corolla tubulosa, limbi lobis profunde divisis, patentibus ; capsula ovata, compressa, glabra, breviter rostratra, mucronata.

Hab. In collibus Babadoodun, *Law* ! ; in montibus Concan et Malabar, *Stocks* !, *Law* !

Suffrutex erectus, ramosus, strigosus. *Caulis* teres. *Cortex* fulvus. *Folia* herbacea, margine plus minus integra, subtus pallida, 2–4 unc. longa, $\frac{1}{2}$–$1\frac{1}{2}$ unc. lata. *Flores* in axillis foliorum superiorum spicatim conglomeratis, seu in axillis foliorum caulinorum solitarii vel bini. *Bracteæ* lineari-lanceolatæ, strigosæ, $\frac{1}{4}$ unc. longæ. *Bracteolæ* bracteis conformes, sed plerumque 3-nerves. *Calycis* segmenta 4, exteriora 1 unc. longa, $\frac{1}{4}$ unc. lata, interiora linearia, occulta, $\frac{1}{2}$ unc. longa. *Corolla* extus incano-pubescens, angusta, $2\frac{1}{2}$ unc. longa. *Capsula* magna, nitida, nigra, tetrasperma, $\frac{3}{4}$ unc. longa.

15. B. involucrata, *N. ab E. in Wall. l. c.* p. 92 ; *DC. l. c.* p. 232. —B. pentandra, *Arn. N. ab E. in DC. l. c.*

Hab. In collibus provinciarum Maisor, Malabar et Concan, et montibus Nilgiri ad alt. 2000–5000 ped., *Law* !, *Stocks* !, *G. Thomson* ! ; in collibus Pulney et Anamallay, *Beddome* ! *Wall. Cat.* 2509 ! ; Zeylania in provincia Ambagamowa, *C. P.* 310, 682, *partim, in hort. botan. Calcutt. culta.*

In Thwaites's 'Enumeration of Ceylon Plants' I adopted Walker Arnott's name *B. pentandra* for this species. I now prefer taking Nees von Esenbeck's specific name, as I find that the species was first described by Nees, and that Walker Arnott's name was an unpublished herbarium one, until adopted by Nees in the 'Prodromus.'

16. B. arnottiana, *N. ab E. in DC. l. c.* p. 232.

Hab. In insula Zeylania prope Newera Ellia ad altitudinem 6000 ped., *Thwaites, C. P.* 310 !, 682 !, *partim*, 2558 ! ; *in hort. botan. Calcutt. culta.*

17. B. vestita, *T. Anders. in Thwaites's Enum. Pl. Zeyl.* p. 230, *cum syn.*

Hab. In provincia centrali insulæ Zeylaniæ, ad altit. 1000–5000 ped.

18. B. MONTANA, *N. ab E. in Wall. l. c.* p. 92, *et DC. l. c.* p. 332, *cum syn.*

Hab. In provincia Concan et in locis montanis Indiæ centralis, *Stocks* !, *Law* !, *Wall. Cat.* 2391 !, *ex herb. Madr.*; ad Jubbulpore, *Beddome* !, *in hort. botan. Calcutt. culta.*

19. B. GIBSONI, *Dalz. in Hook. Journ. of Bot.* ii. p. 339.—B. glauca, *T. Anders. in herb. Kew.*

Hab. In montibus provinciæ Concan, *Gibson* !, *Law* !, *Stocks* !; *in hort. botan. Calcutt. culta.*

20. B. GRANDIFLORA, *Dalz. l. c.*

Hab. In provincia Concan, *Stocks* !; in montibus Syhadree ad Tulkut Ghat, *Dalz.*

21. B. STOCKSII, *T. Anders.* Caule tereti, ramis junioribus hirsutis; foliis sessilibus, ovatis vel lanceolatis, inferioribus basi cordatis, apice mucronatis, chartaceis, nitidis, utrinque glaberrimis, margine minute dentatis, dentibus spinosis, reflexis; floribus axillaribus, sessilibus, solitariis; bracteolis 2 magnis, lanceolatis, margine ciliatis et dense minute spinoso-serratis, patentim hirsutis; calycis segmentis exterioribus magnis, foliaceis, lanceolatis, inferiore bifido, superiore late lanceolato, interioribus subulatis, acutis, ciliatis; capsula disperma, rostrata, parte seminifera subglobosa, retinaculis magnis acutis, seminibus magnis rugosis.

Hab. In collibus Bababoodun, *Stocks* !, *Law* !, *Gibson* !

Suffrutex parvus, strictus, 1–3-pedalis. *Caulis* inferne glaber, superne hispidus, basi usque ad apicem florifer. *Cortex* lævis, pallidus. *Folia* ovata, in ramulis junioribus plerumque lanceolata, ad marginem integra, in aliis undulata vel serrata cum dentibus spinosis, omnia sessilia, superiora ad basin marginemque plus minus ciliata, 1–1¼ unc. longa, 4 lin.–1 unc. lata. *Bracteolæ* apice mucronatæ, erectæ, ad calycem et capsulam adpressæ, 1 unc. et 2 lin. longæ. *Calyx* setis patentibus hirsutus, sepala majora ad medium bifida, interiora parva, conformia, acute subulata, margine ciliata. *Corolla* ignota. *Capsula* glabra, cinerea; valvis ligneis, parietibus portionis seminiferæ chartaceis; placentis ad basin et apicem connatis.

22. B. NUTANS, *N. ab E. in DC. l. c.* p. 227.

Hab. In provincia centrali Zeylaniæ, alt. 1000–3000 ped., *Thwaites, C. P.* 2011 !, 2559 !

23. B. COURTALLICA, *Wight, Icon. Plant. Ind. or.* iv. t. 1529.—B. inæqualis, *Benth. in Flora,* xxxii. p. 557.

Hab. In montibus Concan et Malabar, *Wight* !, *Stocks* !, *Law* !

Corolla pallide cærulea, fide *Jerdon.*

24. B. CONSPICUA, *N. ab E. in Wall. l. c.* iii. p. 92, *cum syn., et in DC. l. c.* p. 226.

Hab. In insula Penang, *Wall. Cat.* 2460 !

25. B. Hochstetteri, *N. ab E. in DC. l. c.* p. 231.—B. Aucheriana, *N. ab E. l. c.* p, 234.
Hab. In Sind, *Stocks*!
Distr. In Muscat!; Arabia Felici!; Nubia!

This species belongs to a small section consisting nearly entirely of Arabian and Abyssinian species. *B. Hochstetteri* is the only species of the section which occurs in India. Stocks has not recorded the locality in Scinde where he obtained his specimens, but he probably found them on the western bank of the Indus.

XX. Neuracanthus, *N. ab E.*

1. N. tetragonostachyus, *N. ab E. in Wall. Pl. As. rar.* iii. p. 97, *et DC. Prodr.* xi. p. 248, *cum syn.*
Hab. Burmah, in collibus ad Prome, *Wall. Cat.* 7168!; in montibus Taong Dong, *Wall. Cat.* 7168!; in Burmah, *Brandis*!

2. N. trinervius, *Wight, Icon. Plant. Ind. orient.* t. 1532.
Hab. In provincia Concan, *Stocks*!, *Law*!, *Gibson*!

3. N. Lawii, *Wight, l. c.* t. 1531.—N. sphærostachyus, *Dalz. in Hook. Journ. of Bot.* ii. p. 140.
Hab. In montibus Malabar et Concan, *Law*!, *Stocks*!, *Gibson*!

XXI. Crossandra, *Salisb.*

1. C. infundibuliformis, *N. ab E. in Wall. Pl. As. rar.* iii. p. 98, *et DC. Prodr.* xi. p. 280, *cum syn.*—C. axillaris, *N. ab E. in Wall. l. c., et DC. l. c.* p. 281.—C. oppositifolia, *N. ab E. in DC. l. c.*
Hab. In Bengal, *Griffith*!; Nipal, *Wall. Cat.* 2364!; in montibus Nilgiri, *G. Thomson*!; in locis aridis provinciarum Kurg, Concan, Canara et Maisor, *Wight*!, *Stocks*!, *Law*!, *Cleghorn*!, *Heyne in Wall. Cat.* 2364!; in Zeylania, *Thwaites, C. P.* 255!, 2016!; Singapore, *Wall. Cat.* 2364!, sed non indigena; *in horto botanico Calc. culta*!

XXII. Lepidagathis, *Willd.*

1. L. cristata, *Willd. Sp. Pl.* iii. p. 400; *N. ab E. in Wall. Pl. As. rar.* p. 96, *et DC. Prodr.* xi. p. 256.
Hab. In collibus aridis saxosis provinciarum Carnatic, *Roxburgh*!, *Wight in herb. Wall.* 2421!, *Elliot*!; in India centrali ad Sagor, *Vicary*!; in Orissa ad Sambulpore, *herb. Griffith*!; in India boreali occidentali, *Royle*!

2. L. rupestris, *Wight in herb. propr.*; *N. ab E. in Wall. l. c. et DC. l. c.*
Hab. In collibus provinciarum Concan et Malabar, *Wight*!, *Stocks*, *Law*!

3. L. Shuteri, *T. Anders.* Caulibus suffruticosis, diffusis, acute an-

gulatis, glabris; foliis sessilibus, lineari-lanceolatis, acutis, basi cordatis, uninerviis, utrinque asperis, margine et ad nervos setoso-hispidis; floribus in capitulis radicalibus dense globosis incano-tomentosis, congestis; bracteis ovatis, acutis, apice aculeatis, uninerviis, tomentosis; bracteolis scariosis, ovate lanceolatis, apice muticis, utrinque dense pubescentibus; calycis segmentis late linearibus acutis. integris, pubescentibus; corolla breviter infundibuliformi, extus tomentosa, limbo bilabiato, labio inferiore longiore, lobis rotundis, obtusis.—Lepidagathis, no. 18 *herb. Ind. orient. Hook. fil. et T. Thoms.*

Hab. In provinciis Maisor et Carnatic, *Shuter*!, *Wight*!, *G. Thomson*!

Caulis pedalis, gracilis, lineis elevatis angulatus. *Folia* aspera, apice mucronata, herbacea, viridia, 1½–2 unc. longa, ¼ unc. lata. *Capitula* omnino radicalia, dense globosa, 1–2 unc. diametro. *Bracteæ* spinosæ mucronatæ.

4. L. TRINERVIS, *N. ab E. in Wall. l. c.* p. 96, *cum syn., et DC. l. c.* p. 254.—Lepidagathis, sp. no. 21, *in herb. Ind. orient. Hook. fil. et T. Thoms.*

Hab. In Bengal et Sikkim, *Griffith*!; in India centrali ad Sagor, *Vicary*!; in provinciis Concan, Canara et Malabar, *Stocks*!, *Law*!, *Gibson*!

5. L. LUTEA, *Dalz. in Hook. Journ. of Bot.* ii. p. 139.

Hab. In rupibus nudis provinciæ Malwan in Concan australiori, *Dalz.*; in provinciis Malabar et Concan, *Stocks*!, *Law*!

6. L. SPINOSA, *N. ab E. in Wall. Pl. As. rar.* p. 97, *et DC. l. c.* p. 258.

Hab. In Maisor et Carnatic, *Wight*!, *G. Thomson*!

7. L. PUNGENS, *N. ab E. in Wall. l. c., et DC. l. c.*

Hab. In provinciis aridioribus Indiæ australis, *Wight in herb. Wall.* 2498!, *G. Thomson in herb. Hook. fil. et T. Thoms.*!

8. L. CLAVATA, *Dalz. in Hook. Journ. of Bot.* ii. p. 340.

Hab. Concan in montibus Syhadree, *Dalz.*!, *Stocks*!

9. L. RIGIDA, *Dalz. l. c.* p. 341.

Hab. In montibus Concan et Syhadree, *Dalz.*!, *Law*!; in Sind, *Stocks*!

10. L. PROSTRATA, *Dalz. l. c.* p. 138.

Hab. In rupibus nudis Concan australioris, *Dalz.*!, *Law*!

11. L. CUSPIDATA, *N. ab E. in Wall. Pl. As. rar.* iii. p. 97, *et DC. l. c.* p. 258.

Var. β. spicis laxis; bracteis uninerviis, spinosis.

Hab. In locis aridis regionis tropicæ montium Himalayæ; in Garhwal et Kumaon, *Wall. Cat.* 2405 A, B!, *Vicary*!, *Edgeworth*!, *Thomson*!, *T. Anders.*; in montibus Concan, *Stocks*!, *Law*!

Var. β in montibus Concan, *Gibson*!

12. L. CALYCINA, *Hochst. in Schimp. Pl. Abyss.*; *N. ab E. in DC. l. c.* p. 252.
Hab. In Sind, *Stocks*!, *Dalz.*!
Distr. In Abyssinia.

13. L. FALCATA, *N. ab E. in Wall. l. c.* p. 96, *et DC. l. c.* p. 249.
Hab. Burmah in collibus prope Taong Dong, *Wall. Cat.* 7166!

14. L. CHLOROSTACHYA, *N. ab E. in DC. l. c.* p. 256.
Hab. Ad Mergui, *Griffith*!

15. L. PURPURICAULIS, *N. ab E. in Wall. l. c.* p. 96, *et DC. l. c.* p. 257.—Ruellia retrofracta, *Wall. Cat.* 7165.—L. striata, *N. ab E. in Wall. Pl. As. rar.* iii. p. 96, *et DC. l. c.*
Hab. In Himalaya, præsertim occidentali, *Wall. Cat.* 2366!, *Griffith*!, *T. Anders.*; in montibus regni Burmah, *Wall. Cat.* 7165!, *MacClelland*!; Behar ad montem Parasnath, *T. Thoms. et T. Anders.*

16. L. DULCIS, *N. ab E. in Wall. l. c.*, *et DC. l. c.* p. 527.—Ruellia dulcis, *Wall. Cat.* 7167.
Hab. In collibus ad Prome, *Wall. Cat.* 7167!

17. L. IRIDESCENS, *T. Anders.* Caule tereti, gracili; foliis petiolatis, elongatis, lanceolatis vel linearibus, utrinque acuminatis, margine integris, supra asperulis, subtus pallidioribus, ad nervos pubescentibus; floribus in spicis densis abbreviatis terminalibus, vel in ramulis axillaribus sessilibus; bracteis herbaceis, oblique lanceolatis, acutis, pubescentibus, margine longe ciliatis; bracteolis subconcavis, oblongis, apice mucronatis, uninerviis, extus sericeo-tomentosis, margine ciliatis; calyce infra medium quinque-partito, segmento superiore maximo, late lanceolato, inferioribus æqualibus, lanceolatis, lateralibus minoribus linearibus, omnibus acutis, longe ciliatis.
Hab. In Burmah prope Rangoon, *MacClelland*!
Caulis glaber vel leviter pubescens. *Folia* caulina lanceolata, summa linearia, inferioribus breviora. *Spicæ* densæ, pubescentes, solitariæ vel 3–4 in capitulo confertæ. *Bracteæ* herbaceæ, margine ciliatæ, 4 lin. longæ. *Bracteolæ* membranaceæ, pallide roseæ, extus sericeæ, margine ciliatæ, 5 lin. longæ. *Calyx* nigrescens, sericeus, 3 lin. longus; segmentis uninerviis. *Corolla* et capsula ignotæ.

18. L. LINEARIS, *T. Anders. in Cat. Hort. Bot. Calcutt.* p. 43. Caule tetragono, alato; foliis subsessilibus, linearibus, utrinque acutis, scabris, subtus pallidis; spicis terminalibus vel axillaribus, tetragonis, subsecundis, densis, lanatis, terminalibus binis vel ternis, axillaribus solitariis; bracteis herbaceis, oblique lanceolatis, mucronatis, margine ciliatis, uninerviis; bracteolis membranaceis, concavis, obovatis, utrinque obtusis, margine ciliatis; calyce quinque-partito, membranaceo, margine ciliato, segmento superiore lanceolato, apice rotundo, trinervi, inferioribus angustioribus, uninerviis, lateralibus an-

guste linearibus, uninerviis; corolla bilabiata, tubo elongato, labio inferiore tripartito, lacinia intermedia late rotundata, lateralibus ovatis, labio superiore obscure bifido, rotundo; staminibus inclusis, filamentis æqualibus, antheris ovatis; stylo incluso, filiformi; capsula lanceolata, acuta, mucronata, glabra, tetrasperma.

Hab. In Burmah, *R. Scott, hortulanus hort. Bot. Calc.* In hort. bot. Calc. culta!

Herba perennis, pluricaulis, 2–3-pedalis. *Caulis* glaber, tetragonus, alatus. *Cortex* cinereus. *Folia* scabra, nervo medio pallide flavo, 3–6 unc. longa. *Spicæ* incano-lanatæ 1–2 unc. longæ. *Corolla* usque ad faucem inter bracteas et calycem occulta, glabra, fauce et labiis maculis parvis purpureis notatis. *Capsula* parva, calyce inclusa.

19. L. SCARIOSA, *N. ab. E. in Wall. l. c.* p. 95, *et DC. l. c.* p. 251. —Ruellia scariosa, *Wall. Cat.* 2354.

Hab. In collibus umbrosis provinciæ Carnatic, *Wall. Cat.* 2354!

20. L. NEUROPHYLLA, *T. Anders.* Caule tetragono, glabro; foliis petiolatis, ovatis, acutis, basi in petiolum attenuatis, utrinque glabris, grosse pinnatim nervosis, margine integris; spicis terminalibus, dichotome divisis, pubescentibus; bracteis et bracteolis subherbaceis, lineari-lanceolatis, longe mucronatis, ciliatis, uninerviis; calyce 5-partito, laciniis lineari-lanceolatis, longe mucronatis, glanduloso-ciliatis; corolla tubo angusto, limbo profunde bilabiato, labio inferiore tripartito, lacinia media ovata, lateralibus linearibus; labio superiore ovato, apice emarginato; staminibus inclusis.—Lepidagathis, sp. no. 13 *herb. Ind. or. Hook fil. et T. Thoms.*!

Hab. In montibus provinciæ Concan, *Stocks*!

Planta herbacea, glabra. *Caulis* inter nodos abbreviatus. *Folia* cum petiolo 3–7 unc. longa, 1½–2 unc. lata supra viridia, nitida, subtus pallida, utrinque glaberrima venis prominentibus, in sicco albis. *Spicæ* secundæ, mucronatæ, pubescentes, multifloræ, 1–3 unc. longæ. *Bracteæ* et *bracteolæ* conformes, glumaceæ, breviter mucronatæ, fere aristatæ, margine molliter ciliatæ, 4–6 lin. longæ. *Calyx* parvus segmentis breviter aristatis. *Corolla* bracteis et bracteolis longior, glabra, tubo recto, angusto, 2 lin. longo; limbo dilatato glabro, maculis flavis notato.

21. L. SIMPLEX, *T. Anders.* Caule simplici, tetragono; foliis rigidis, decussatim oppositis, sessilibus, lanceolatis vel oblanceolatis, basi attenuatis, apice subobtusis, margine integris vel undulatis; spicis solitariis, terminalibus, ovatis, secundis; bracteis herbaceis, lanceolatis, acutis, uninerviis, margine ciliatis; bracteolis glumaceis, ovatis, acutis, paulo concavis, reticulatim venosis, margine et dorso ciliatis; calyce profunde quinque-partito, segmentis superioribus et inferioribus lanceolatis, acutis, lateralibus linearibus, omnibus ciliatis; capsula ovata,

mucronata, glabra, tetrasperma; seminibus compressis, conicis, mucronatis, glabris.

Hab. In provincia Tenasserim, *Helfer*!

Herba simplex 6–10-uncialis. *Caulis* adscendens, purpureus, glaber. *Folia* nitida, uninervia, reticulatim venosa, 6 lin.–$1\frac{1}{2}$ unc. longa, 1–4 lin. lata. *Spicæ* siccæ, bracteis viridibus herbaceis variegatæ, leviter sericeæ, $\frac{1}{2}$–1 unc. longæ. *Bracteæ* 3 lin. longæ, $1\frac{1}{2}$ lin. latæ, obliquæ.

22. L. HYALINA, *N. ab E. in Wall. l. c.* p. 95, *et DC. l. c.* p. 252.—L. riparia, *N. ab E. in DC. l. c. cum syn.*

Var. β. foliis lanceolatis, repandis, basi attenuatis, glabris.—L. semiherbacea, *N. ab E. in DC. l. c.* p. 253.

Var. γ. caule subrepente, foliis ovatis, bracteolis calycibusque villoso-ciliatis.—L. mucronata, *N. ab E. in Wall. l. c.* p. 95, *et DC. l. c.* p. 250.

Var. δ. caule humili, basi repente; foliis ovalibus, subsessilibus.—L. ustulata, *N. ab E. in Wall. l. c.* p. 95,

Hab. In sylvis montanis tropicis; in Bengal, *Hook. fil. et T. Thoms.*!, *Vicary*!; Assam et montibus Khasia, *Wall. Cat.* 2365!, *Griffith*!, *Hook. fil. et T. Thoms.*!, *Jenkins*!, *Simons*!, *Masters*!; in Himalaya a Bhotan usque ad Gharwal, *Wall. Cat.* 2365! et 3565!, *Hook. fil. et T. Thoms.*!, *Griffith*!; Behar ad montem Parasnath, *T. Thoms. et T. Anders.*; Sumbulpore, *Griffith*!; in montibus Carnatic et Anamallay, *Cleghorn*!, *Beddome*!; in Burmah ad Prome, *Wall. Cat.* 2365!; in ripis fluminis Atran ad Pegu, *Wall. Cat.* 7163, *M'Clelland*!, *R. Scott*!; Rangoon, *Cleghorn*!; Moulmein, *Falconer*!, *Brandis*!, *Helfer*!

Var. β. Moulmein, *Wall. Cat.* 7164!; Pegu, *Brandis*!; Assam, *Simons*!; Sikkim, *T. Thomson*!

Var. γ. Kamaon, *Royle*!, *T. Thoms.*!; in provinciis Maisor et Carnatic, *G. Thoms.*!, *Heyne in herb. Wall.* 2366!

Var. δ. Kamaon, *T. Thoms.*!; ad Bagesur in ripa fluminis Surjoo, *T. Anders.*

Distr. China!

23. L. CEYLANICA, *N. ab E. Ill. Lepidag.* p. 35, *et DC. l. c.* p. 259.—L. nervosa, *Wight Ic. Pl. Ind. orient.* t. 1620.

Hab. Insula Zeylania, ad alt. 4000 ped., *Thwaites, C. P.* 1985!, *T. Thomson*!

24. L. FASCICULATA, *N. ab E. in Wall. l. c.* p. 95, *et DC. l. c.* 260.—L. Goensis, *Dalz. in Hook. Journ. of Bot.* ii. p. 340.

Hab. In collibus siccis et calidis Behar, Malwah, Malabar et Concan, *Beddome*!, *Dalz.*!, *Stocks*!, *Law*!; in Burmah ad Rangoon, *Cleghorn*!; ad basin collis Pabang prope flumen Atran, *Wall. Cat.* 2394!; Pegu, *Brandis*!; ad Moulmein, *Falconer*!, *Helfer*!; in insula Zeylania, *Thwaites, C. P.* 1983!

25. L. Walkeriana, *N. ab E. in DC. l. c.* p. 260; *Wight Icon. Plant. Ind. orient.* t. 1530.

Hab. In insula Zeylania, *Thwaites, C. P.* 85!, 1986!

26. L. Neesiana, *Wight, MSS. in herb. propr. absque descriptione.* Caulibus basi procumbentibus, teretibus, junioribus subtetragonis; foliis sessilibus, ovatis, apice acutis vel rotundatis, dense incano-velutinis, margine et venis pilis fulvis sparse ciliatis; spicis terminalibus, simplicibus, tetragonis, dense incano-sericeis; bracteis imbricatis, ovatis, acutis, pubescentibus, margine longe ciliatis; bracteolis parvis, subulatis; calyce profunde quinque-fido, glandulose piloso, segmentis lanceolatis acutis; corolla subhypocraterimorpha, bilabiata, labio superiore ovato, minute bifido, inferiore tripartito, lobis ovatis, apice mucronatis; staminibus 4, didynamis, inclusis, filamentis brevibus; antheris staminum superiorum bilocularibus, loculis distinctis, divaricatis, staminum inferiorum abortu unilocularibus, connectivo piloso; capsula tetrasperma.

Hab. Palamcottah in solo nigro, *Wight*!

Planta herbacea, diffusa, dense incano-velutina, pilis sericeis patentibus flavis obtecta. *Caules* veteres plus minus lignosi. *Folia* utrinque dense velutina, incana, ovata, 1–2 unc. longa, $\frac{1}{4}$–1 unc. lata. *Spicæ* 1–2 unc. longæ, incano-sericeæ. *Bracteæ* 6–8 lin. longæ, bracteolis et calyce multo longiores.

27. L. Beddomei, *T. Anders.* Caule gracili, tetragono, glabro; foliis decussatim oppositis, sessilibus, lanceolatis, mucronatis, fragilibus, margine crustaceis, minute serrulatis; floribus terminalibus, paucis, subspicatis seu solitariis; bracteis lanceolatis, acutis, mucronulatis; calyce herbaceo, quadripartito, segmentis 2 linearibus, acutis, margine ciliatis, uninerviis, 2 majoribus lanceolatis; corolla extus pubescente, infundibuliformi, portione infundibuliformi elongata, tubo brevi, lobis inæqualibus, superiore cæteris breviore, bifido; staminibus quatuor inclusis; antheris bilocularibus.

Hab. Jubbulpore in India centrali, *Beddome*!

Planta herbacea, erecta, 6–8-uncialis? *Folia* 1–2 unc. longa, 3–4 lin. lata, patentia, glabra, uninervia. *Corolla* 10 lin. longa, infundibuliformis.

This plant is probably most nearly allied to the group of species of which *L. aristata* is the type. It resembles *L. Heudelotiana* from Senegambia in its terminal flowers.

28. L. longifolia, *Wight, Ic. Pl. Ind. orient.* t. 1564.

Hab. In peninsula Malayana ad Malacca, *Griffith*!

XXIII. Blepharis, *Juss.*

Sect. 1. Eublepharis.

1. B. asperrima, *N. ab E. in DC. Prodr.* xi. p. 267.

Hab. In locis montanis Concan et Maisor, *Stocks*!, *Law*!

2. B. BOERHAAVIÆFOLIA, *Pers. Syn.* ii. p. 180; *N. ab E. in Wall. Pl. As. rar.* iii. p. 97, *et DC. l. c.* p. 266.—Acanthus Maderaspatensis, *Linn. Sp. Pl.* p, 639.—A. ciliaris, *Burm. Fl. Ind.* p. 139, t. 42.—Blepharis Abyssinica, *Hochst. in Schimp. Iter. Abyss.* 247, 1492, et 1895.

Hab. In locis aridis et arenosis Indiæ frequens; Behar, *Hook. fil.*!; in planitie Gangetica superiore ad Moradabad, *T. Thoms.*!; Saharunpore, *Royle*!; ad Banda, *Edgeworth*!; Malabar, Carnatic et Maisor, *G. Thomson*!, *Stocks*!, *Law*!, *Cleghorn*!, *Elliot*!, *Wight*!, *Heyne in herb. Wall.* 2513!; in Burmah ad Ava et Prome, *Wall. Cat.* 2513!, *Griffith*, n. 6145!; in Zeylania, *Thwaites, C. P.* 2014!

Distr. Abyssinia!, Senegambia!, Guinea!

3. B. MOLLUGINIFOLIA, *Pers. Syn.* ii. p. 180; *N. ab E. in Wall. l. c., et DC. l. c.* p. 266.—Acanthus Maderaspatanus, *Linn. MSS. in herb. suo, sed non Sp. Plant.*—A. repens *Vahl, Symb.* ii. p. 76.—Blepharis repens, *Roth, Nov. Plant. Sp.* p. 321.

Hab. In aridis Indiæ orientalis a Zeylania usque ad gradum latitudinis borealis 29; in planitie Carnatic, *Heyne in herb. Wall.* 2514!, *Cleghorn*!; Malabar et Concan, *Stocks*!, *Law*!; Canara, *Law*!, *Gibson*!; in India centrali ad Sagor, *Vicary*!; in planitie Gangetica superiore ad Moradabad, *Thomson*!; ad Banda, *Edgeworth*!; in insula Zeylania, *Thwaites, C. P.* 3576!

Sect. 2. ACANTHODIUM. *Rami procumbentes; flores dense spicati; spicis tetrastachyis, multifloris; bracteis imbricatis.*

4. B. SINDICA, *Stocks, MSS. in herb. Wight.*—Acanthodium grossum, *Wight, Ic. Plant. Ind. orient.* t. 1535 et 1536, *non N. ab E. in DC. l. c.* p. 274.—A. hirtum, *Planchon in herb. Kew, sed non* A. hirtum, *Hochst. in Kotsch Pl. Nub.* 256, *et N. ab E., DC. l. c.*

Hab. In deserto Sindico, *Stocks*!

See a note on this species in the 'Journal of the Proceedings of the Linnean Society,' vii. p. 36.

5. B. EDULIS, *Pers. Syn.* ii. p. 180.—Acanthodium spicatum, *Delile, Fl. Ægypt.* p. 97, t. 33. fig. 3; *N. ab E. in DC. l. c.* p. 274.—Acanthus edulis, *Vahl, Symb.* i. p. 48.—Ruellia persica, *Burm. Fl. Ind.* p. 135, t. 42. fig. 1.—Acanthus Delilii, *Spreng. Syst.* ii. 819.

Hab. In Punjab ad Multan, *Edgeworth*!; Sind et Beloochistan, *Stocks*!; Affghanistan, *Griffith*!

Distr. Persia!; Arabia Felici et Petræa!; Abyssinia!; Nubia!; Ægyptus!

XXIV. ACANTHUS, *Linn.*

1. A. CARDUACEUS, *Griff. Itin. Notes*, p. 144; *Notulæ*, iv. 138; *Private Journals*, p. 356. "Frutex scandens, caule robusto; foliis pinnatifidis, laciniis lobatis et dentatis, spinosissimis, atro-viridibus; spicis

axillaribus et terminalibus, illis longe pedunculatis, pedalibus, tetrastachyis, erectis ; bracteis ovatis, subreflexis, spinoso-dentatis, margine lunato-ciliatis, floribus albis; bracteis lanceolatis etiam lanatis."

Hab. In montibus Bhotan ad Bhoomlungtun et Oongar, *Griffith*, n. 688!

"Planta præconspicua, in rupibus scandens."

In a note Griffith says, "used to feed black cattle." This is without doubt the most interesting of all the Indian *Acanthaceæ*. It is a true typical *Acanthus*, of the same series as the Mediterranean species, which have no representatives in Asia nearer Bhotan than Dahuria. *A. carduaceus* is also very local in its distribution, having been found nowhere to the west of Bhotan ; and, indeed, Griffith met with it only twice, and remarks that at Oongar it has a very restricted range in latitude. With the exception of *Acanthus volubilis* of the estuaries of the Ganges and some Burmese rivers, and of course the suborder *Thunbergideæ*, this is the only scandent Acanthaceous plant known.

2. A. LEUCOSTACHYUS, *Wall. Cat.* 2512; *N. ab E. in Wall. Pl. As. rar.* iii. p. 98, *et DC. l. c.* p. 270.

Hab. In Assam ad Gowhatty, *Masters*!, *Jenkins*!, *Simons*!; in montibus Khasia, ad alt. 1000–4000 ped., *Wall.* 2512!, *Hook. fil. et T. Thoms.*!, *Griffith*!

3. A. ILICIFOLIUS, *Linn. Sp. Pl.* p. 639.—Dilivaria ilicifolia, *Juss. Gen. Plant.* p. 115, *et N. ab E. in Wall. l. c.* p. 98, *et DC. l. c.* p. 268.

Hab. In littoribus salsis tropicis frequentissimus in India a littore australi Zeylaniæ usque ad æstuarium Gangeticum; atque in æstuariis Birmannicis et Malayanis, *Heyne in herb. Wall.* 2511!, *Roxburgh*!, *Griffith*!, *Law*!, *Cleghorn*!, *Falconer*!, *Hook. fil. et T. Thoms.*!, *Thwaites, C. P.* 2017!;—*in horto botanico Calcutt. indigenus et cultus*!

Distr. Per totum archipelagum Malayanum et insulas Moluccas et Philippinas; China, ad Hongkong; ad littora Australiæ et Africæ tropicæ.

4. A. EBRACTEATUS, *Vahl, Symb.* ii. p. 75, t. 40.—Dilivaria ebracteata, *Pers. Syn.* ii. p. 179; *N. ab E. in Wall. l. c.* p. 98, *et DC. l. c.* p. 269.

Hab. In æstuario Chappedong, *Wall. Cat.* 7159!; in peninsula Malayana ad Malacca et Penang, *Wall. Cat. sub numero* 2511! et 7169!

Distr. Java!, Moluccas.

5. A. VOLUBILIS, *Wall. Pl. As. rar.* ii. p. 56, t. 172.—Dilivaria scandens, *N. ab E., DC. l. c.* p. 269.

Hab. In æstuariis Gangeticis et fluminum Birmannicorum et Malayanorum, *Wallich*!, *Falconer*!, *Griffith*!, *R. Scott*!

Distr. Java!, Moluccas!

XXV. Andrographis, *Wall.*

1. A. Neesiana, *Wight, Ic. Pl. Ind. orient.* t. 1561.—Andrographis no. 13 et 14, *herb. Hook. fil. et T. Thoms.* !

Hab. In montibus provinciarum Malabar, Concan et Kurg, *Stocks* !, *Law* !, *Gibson* !, *G. Thomson* !; in collibus Shevaroy, *Wight* !; in montibus Pulney, *Beddome* !

2. A. lineata, *N. ab E. in Wall. Pl. As. rar.* iii. p. 116, *et DC. l. c.* p. 516—Justicia lineata, *Wall. Cat.* 2486 a. *partim*.

Hab. In montibus Nilgiri, *Wight* !

3. A. viscosula, *N. ab E. in Wall. l. c., et DC. l. c.* p. 507.—Justicia lineata, *Wall. Cat.* 2486 b.

Hab. In Carnatic, *Heyne in herb. Wall.* 2486 b ; ad Courtallum, *Wight* !

4. A. affinis, *N. ab E. in Wall. l. c., et DC. l. c.*

Hab. In montibus Malabaricis "Bababoodun" dictis, *Law* !; in provincia Maisor, *G. Thomson* !

5. A. paniculata, *N. ab E. in Wall. l. c., et DC. l. c.* p. 515.—Justicia paniculata, *Burm. Fl. Ind.* p. 9.

Hab. In planitie Indiæ orientalis et Zeylaniæ sub umbra arborum, Bengal, *Hook. fil. et T. Thoms.* !; Assam, *Masters* !, *Simons* !; in montibus Khasia, *Hook. fil. et T. Thoms.* !; Behar, *T. Thoms.* ! *et T. Anders.*; Carnatic, *Heyne in herb. Wall.* 2454 !; in planitie Gangetica superiore, *Royle* !; Lucknow, *T. Anders.*; in Zeylania, *Thwaites, C. P.* 1981 *partim*, et 3664 ! In hort. bot. Calc. indigena et culta, *Wall. Cat.* 2454 !

Distr. Java !; in insulis Antillis introducta.

6. A. alata, *N. ab E. in DC. l. c.* p. 516.—Justicia alata, *Vahl, En.* i. p. 139.

Hab. In insula Zeylania, *Thwaites, C. P.* 1977 !; ad Coimbatore, *Wight* !

7. A. elongata, *T. Anders.*—Cryptophragmium cordifolium, *N. ab E. in Wall. l. c.* p. 100.—C. elongatum, *N. ab E. in DC. l. c.* p. 95.

Hab. In provincia Carnatic ad Tranquebar, *Heyne in herb. Wall.* 2482 !; ad Courtallum, *Wight* !

8. H. tenuiflora, *T. Anders.*—Justicia tenuiflora, *Wall. Cat.* 7185. —Haplanthus tener, *N. ab E. in Wall. l. c.* p. 115, *et DC. l. c.* p. 512, excl. var. β.

Hab. In collibus prope Prome, ad Taong Dong, *Wall. Cat.* 7185 !

9. A. Ceylanica, *N. ab E. in DC. l. c.* p. 518.

Hab. In insula Zeylania, *Walker in herb. Hooker* !

10. A. Wightiana, *N. ab E. in DC. l. c.* p. 517.—A. macrobotrys, *N. ab E. l. c.* p. 516.

Hab. In montibus provinciæ Malabar, *Wight* !; in collibus Pulney; in insula Zeylania, *Thwaites, C. P.* 3578 !, 1981, *partim* !

11. A. GRACILIS, *N. ab E. in DC. l. c.* p. 516.

Hab. In provincia Carnatic ad Courtallum, *Wight*!, *G. Thomson*! *in herb. Hook. fil. et T. Thoms.*

12. A. ECHIOIDES, *N. ab E. in Wall. l. c.* p. 117, *et DC. l. c.* p. 518.—Justicia echioides, *Linn. Fl. Zeyl.* p. 8. n. 21.

Hab. In locis montanis et aridis Indiæ orientalis; in Panjab et planitie Gangetica superiore, *Royle*!, *T. Thomson*!, *T. Anders.*; ad Sagur, *Vicary*!; in provinciis Carnatic, Maisor et Canara, *Cleghorn*!, *Elliot*!, *Law*!; in insula Zeylania, *Thwaites, C. P.* 606!; in Burmah ad Ava, *Wall. Cat.* 2439! In horto botanico Calcuttensi culta, *Wall. Cat.* 2439!

13. A. SERPYLLIFOLIA, *Wight, Ic.* t. 517.—Erianthera serpyllifolia, *N. ab E. in Wall. l. c. et DC. l. c.*—Justicia serpyllifolia, *Vahl, En.* i. p. 169.

Hab. Maisor et Carnatic, *Wall. Cat. ex herb. Madras,* 2461 A, B, C!; ad Palmacottah, *Wight*!

14. A. LOBELIOIDES, *Wight. Ic.* t. 1557.—Erianthera lobelioides, *N. ab E. in Wall. l. c.* p. 115, *et DC. l. c.* p. 514.

Hab. In pascuis montanis jugi Nilgiri, *Wight*!

XXVI. HAPLANTHUS, *N. ab E.*

1. H.? HYGROPHILOIDES, *T. Anders.* Foliis petiolatis, ovatis, acutis, margine integris, utrinque tomentosis, venis furfuraceis; floribus in axillis foliorum caulinorum aggregatis, bracteis minutis, linearibus, subulatis; calyce quinquepartito, segmentis æqualibus, subulatis, acutis; corolla infundibuliformi, limbo bilabiato, lobis rotundis, æqualibus, fauce brevi; staminibus duobus æqualibus, filamentis ligulatis alatis, antheris bilocularibus loculo postico barbato.

Hab. In Burmah ad Pegu, *Brandis*!

Planta neglecta. *Caules* plures quadrangulares furfuracei. *Folia* ovata, 1–1¼ unc. longa, ½–1 unc. lata, minute lineolata. *Bracteæ* 3 lin. longæ. *Calyx* 3 lin. longus. *Corolla* parva, extus pubescens, tubo angusto. *Capsula* linearis, compressa, glandulosa, polysperma.

It is with the greatest hesitation that I place this plant even provisionally in *Haplanthus*. The specimens I possess are very imperfect, so that I have been able to examine only one flower. The plant is evidently an insignificant weed. I at first referred the species to *Hygrophila*, but, after examining the flower, I was induced to remove it to its present place.

2. H. TENTACULATUS, *N. ab E. in DC. l. c.* p. 513.—Ruellia tentaculata, *Linn. in Amœn. Acad.* iv. p. 320.

Hab. In India centrali ad Sagur, *Jerdon*!; Canara et Concan, *Stocks*!, *Law*!

3. H. PLUMOSUS, *T. Anders.* Foliis longe petiolatis, ovatis, apice acutis, basi in petiolo decurrentibus; floribus axillaribus, interdum sessilibus, plerumque in apice ramorum spicatim dispositis; bracteis bracteolisque linearibus quadrangularibus glanduloso-viscosis, apice breviter bifidis; calyce quinquefido, segmentis aristatis, margine setoso-ciliatis; corolla infundibuliformi, curvata, indistincte bilabiata, lobis æqualibus, lanceolato-ovatis; staminibus inclusis, filamentis brevibus, ligulatis, alatis, antheris bilocularibus; capsula lanceolata acuta, mucronulata, octosperma.—Haplanthus, sp., n. 4, *herb. Hook. fil. et T. Thoms.*

Hab. Concan, *Stocks*!, *Law*!

Planta 2–3-pedalis, tomentosa. *Caules* veteres sublignosi, teretes, defoliati, molliter pubescentes, juniores tetragoni. *Folia* 2–8 unc. longa, 1–3 unc. lata, herbacea, sparse pubescentia. *Bracteæ* et *bracteolæ* graciles, ½–1 unc. longæ. *Calyx* parvus, 3 lin. longus, segmentis subulatis, sericeo ciliatis. *Corolla* glabra, 4 lin. longa.

4. H. VERTICILLARIS, *N. ab E. in DC. l. c.*

Hab. In India centrali ad Sagur, *Vicary*!; in montibus provinciarum Malabar et Concan, *Stocks*!, *Law*!; in collibus Anamallay, *Beddome*!

XXVII. GYMNOSTACHYUM, *N. ab E.*

1. G. PARISHII, *T. Anders.* Ramis oppositis, foliis longioribus; foliis radicalibus petiolatis, ovatis, caulinis breviter petiolatis, ovatis vel lanceolatis, supra pilis sparse obtectis, subtus glabris, margine integris; floribus circa apicem ramorum aggregatis vel in spicis paucifloris subsecundis dispositis; bracteis et bracteolis a calyce paulo remotis, minutis, subulatis, calyce ad basin æqualiter 5-fido, segmentis linearibus, acutis; corolla infundibuliformi, bilabiata, lobis ovatis obtusis, tubo incurvo; staminibus inclusis, filamentis brevibus ligulatis alatis margine ciliatis, antheris tomentosis.—Haplanthus tener, var. β. elongata, *N. ab E. in DC. l. c.* p. 513.

Hab. Tavoy, *Wall. Cat.* 7185 A; Moulmein, *Parish*!, *Scott*!; insulis Andaman, *Helfer*!

Caulis 8-uncialis–1-pedalis, erectus, tetragonus, sparse hirsutus. *Folia* 1–3 unc. longa, ½–1½ unc. lata, in petiolum gradatim transeuntia. *Flores* breviter pedicellati, remoti. *Calyx* parvus, 2 lin. longus, glaber vel sparse glandulosus. *Corolla* 4 lin. longa, incurva, extus pubescens, intus glabra, purpurea.

2. G. ANDROGRAPHIOIDES, *T. Anders.* Caule erecto, ramoso; foliis petiolatis, ovatis, apice acuminatis, superioribus sessilibus, basi rotundis vel subcordatis, utrinque glabris; floribus paniculatis, breviter pedicellatis, bracteis et bracteolis conformibus, minutis, subulatis; calyce ad basin quinquefido, sparse glanduloso, segmentis subulatis acutis; corolla incurva infundibuliformi, limbo obscure bilabiato, lobis labii inferioris æqualibus ovatis obtusis, labio superiore profunde bi-

partito; filamentis brevibus, alatis; antheris barbatis, loculis sterilibus basi breviter calcaratis; stylo ciliato, stigmate subulato glabro; capsula elongata, lineari-lanceolata, pubescente, polysperma.

Hab. Assam, *Masters*!; Burmah, *Griffith*!

Planta gracilis, facie *Andrographidis paniculatæ*, 1–2-pedalis. *Caulis* herbaceus, tetragonus, glaber. *Folia* opposita, late ovata, 2–4 unc. longa, 1–2 unc. lata. *Paniculæ* pauciflorae, glabræ. *Flores* remoti, oppositi, breviter pedicellati. *Bracteæ* parvæ, subulatæ. *Capsula* 8–10 lin. longa, pubescens.

3. G. HIRSUTUM, *T. Anders. in Thwaites's En. Pl. Zeyl.* p. 233.

Hab. In provincia centrali insulæ Zeylaniæ, ad alt. 3000 ped., *C. P.* 2473.

4. G. PANICULATUM, *T. Anders. in Thwaites, l. c.* p. 232.

Hab. In insula Zeylania, *Thwaites, C. P.* 2994!

5. G. CANESCENS, *T. Anders.*—Cryptophragmium canescens, *N. ab E. in DC. l. c.* p. 95.

Hab. In provinciis Maisor et Carnatic, *G. Thomson*! *in herb. Hook. fil. et T. Thoms.*!; ad Courtallum, *Wight*.

6. G. SERRULATUM, *T. Anders.*—Cryptophragmium serrulatum, *N. ab E. in DC. l. c.* p. 95, *cum syn.*

Hab. In provincia Carnatic, *Heyne in herb. Wall.* 2452 A.

7. G. TOMENTOSUM, *T. Anders.* Caule tetragono, glanduloso, tomentoso, angulis obtusis; foliis floralibus ovatis, apice acutis, basi in petiolum constrictis, margine undulatis, utrinque hirsutis, subtus canescentibus; spicis axillaribus terminalibusque, densifloris, trichotome ramosis; floribus pedicellatis; bracteis linearibus, acutis, glandulose ciliatis; calyce profunde 5-fido, segmentis aristatis ciliatis scabriusculis; corolla subcylindrica, extus pubescente, limbo bilabiato, lobis æqualibus obtusis; staminibus inclusis, filamentis ligulatis angustis, antherarum loculis æqualibus glabris; capsula elongata lineari, subtereti, mucronulata.

Hab. In India centrali, *Beddome*!

Planta perennis, herbacea, glandulosa, tomentosa, erecta, 1–2-pedalis. *Folia* floralia herbacea, glanduloso-tomentosa vel scabriuscula, subsessilia, ovata, 1 unc. longa, 6 lin. lata, inferiora ignota. *Bracteæ* lineares, aristatæ, glandulosæ, 3 lin. longæ. *Calyx* 5 lin. longus. *Pedicelli* calyce breviores, filiformes. *Corolla* anguste cylindrica, recta, 6–8 lin. longa, pubescens. *Capsula* fere 1 unc. longa, polysperma, retinaculis erectis acutis.

8. G. LATIFOLIUM, *T. Anders.*—Cryptophragmium latifolium, *Dalz. in Hook. Journ. of Botany*, ii. p. 137.

Hab. In montibus provinciarum Malabar et Concan, *Dalzell*!, *Stocks*!, *Law*!, *Gibson*!

9. G. SANGUINOLENTUM, *T. Anders. in Thwaites's En. Pl. Zeyl.* p. 232.—Cryptophragmium sanguinolentum, *N. ab E. in DC. l. c.* p. 96.—C. axillare, *N. ab E. l. c.*—Justicia sanguinolenta, *Vahl, Symb.* ii. p. 10.

Hab. In insula Zeylania, *Thwaites, C. P.* 186!

10. G. GLABRUM, *T. Anders.*—Cryptophragmium glabrum, *Dalz. in Hook. Journ. of Botany,* ii. p. 338.

Hab. In sylvis provinciæ Concan australis, *Dalzell*!, *Stocks*!, *Law*!

11. G. VENUSTUM, *T. Anders.*—Cryptophragmium venustum, *N. ab E. in Wall. Pl. As. rar.* iii. p. 100, *et DC. l. c.* p. 94.—Justicia venusta, *Wall. l. c.* i. p. 53, t. 66.

Hab. In montibus Khasiæ, *Wall. Cat.* 2470!, *Griffith*!, *Hook. fil. et T. Thoms.*!

12. G. CEYLANICUM, *N. ab E. in DC. l. c.* p. 93.

Hab. In insula Zeylania, *Thwaites, C. P.* 2019!

13. G. ALATUM, *Wight, Icon. Plant. Ind. Orient.* t. 1525.—G. febrifugum, *Benth. in Flora,* xxxii. p. 558.

Hab. In provincia Canara ad Mangalore, *Wight*!

XXVIII. PHLOGACANTHUS, *N. ab E.*

1. P. THYRSIFLORUS, *N. ab E. in Wall. Pl. As. rar.* iii. p. 99, *et DC. l. c.* p. 321.—Justicia thyrsiflora, *Roxb. Fl. Ind.* i. p. 114.

Hab. In sylvis montanis tropicis jugorum Himalayæ et Khasiæ; Khasia, *Wall.* 2430!; ad fluvium Borpanee, *Simons*! *H. f. et T. T.*!; in Assam, *Masters*!, *Booth*!, *Jenkins*!; Bhotan, *Griffith*!; Sikkim, *Hook. fil. et T. Thoms.*!; Kumaon et Gharwal, *Royle*!; ad Rangoon in Burmah, *Cleghorn*!, sed certe ex horto. In horto botanico Calcuttensi cultus.

2. P. CURVIFLORUS, *N. ab E. in Wall. l. c.* p. 99, *et DC. l. c.* p. 320. —Justicia curviflora, *Wall. Pl. As. rar.* ii. p. 9, t. 112.

Hab. In montibus Khasiæ, *Wall. Cat.* 2429!, *Griffith*!, *Hook. fil. et T. Thoms.*!, *Masters*!, *Simons*!, *Oldham*! Olim in hort. bot. Calc. cultus.

3. P. TUBIFLORUS, *N. ab E. in Wall. l. c. et DC. l. c.* p. 321.—Justicia tubiflora, *Wall. Cat.* 2428.—Loxanthus Gomezii, *N. ab E. in Wall. l. c. et DC. l. c.* p. 322.

Hab. In montibus Khasiæ et Jynteæ, *Wall.* 7170!, *Hook. fil. et T. Thoms.*!, *Griffith*!; in Assam ad Gwalpara, *Hamilton in herb. Wall.* 2428!, *Jenkins*!, *Masters*!, *Simons*!

4. P. PARVIFLORUS, *T. Anders.* Foliis herbaceis, petiolatis, ovatis, apice caudatis, acutis, basi in petiolo decurrentibus, margine integris, utrinque glaberrimis; racemis terminalibus, erectis, paucifloris, glabris, pedunculis oppositis, 3–4-floris, pedicellis brevibus, pube-

scentibus; bracteis a floribus remotis, parvis, subulatis; calyce 5-partito, segmentis æqualibus; corolla cylindrica, subcoriacea, glabra, limbo obscure bilabiatim diviso; labio inferiore trifido, lobis æqualibus, ovalibus; superiore minute bifido; antheris inclusis.

Hab. In collibus Mishmi, *herb. Griffith*!, *Kew Distr.* n. 6155.

Planta suffruticosa. *Caulis* tetragonus, glaber, angulis obtusis. *Folia* cum petiolo 6-uncialia vel pedalia, 2–4 unc. lata; petiolo 1–2 unc. longo. *Racemus* 3–5 unc. longus, rachi subtetragona, glabra. *Pedunculi* graciles, ½ unc. longi. *Corolla* 1 unc. longa, glabra. *Antheræ* lineares, muticæ, glabræ. *Filamenta* ligulata, glabra. *Stylus* subulatus, integer, glaber. *Capsula* ignota.

5. P. GUTTATUS, *N. ab E. in Wall. l. c. et DC. l. c.* p. 321.—Justicia guttata, *Wall. Pl. As. rar.* i. p. 24, t. 28.

Hab. In montibus Khasiæ, *Wall. Cat.* 2431!, *Griffith*!; in collibus "Naga" dictis, *Masters*!, *Simons*!; in jugo montium Himalayæ ad Dewangiri in provincia Bhotan, *Simons*!

6. P. VITELLINUS, *T. Anders.*—Endopogon vitellinus, *N. ab E. in DC. l. c.* p. 723.—Justicia vitellina, *Roxb. Fl. Ind.* i. p. 115.—Phlogacanthus asperulus, *N. ab E. in Wall. l. c. et DC. l. c.* p. 321.—Justicia asperula, *Wall. Cat.* 7171, *Bot. Cab.* t. 1681.—J. quadrangularis, *Wall. Cat.* 2451, *et Hook. Bot. Mag.* t. 2845.

Hab. In Himalaya in sylvis tropicis a Bhotan orientali ad Sikkim, *Griffith*!, *T. Thomson*!; in Assam, *Masters*!, *Simons*!; in collibus prope Chittagong, *Roxburgh*! In horto bot. Calc. cultus.

The synonymy shows that this species has been twice described by Nees, first as *Phlogacanthus asperulus*, and again in the supplementary part of the 11th volume of DeCandolle's 'Prodromus,' as *Endopogon vitellinus*. There is an excellent drawing of *Justicia vitellina* among Roxburgh's coloured figures of Indian plants in the Library of the Botanical Gardens. The living plants in the garden are still known to the native gardeners as *Justicia asperula*, the name taught them by Wallich. There can be no doubt about the identity of Roxburgh's *Justicia vitellina* and Wallich's *J. asperula*.

7. P. PULCHERRIMUS, *T. Anders.* Caule pubescente; foliis oppositis, petiolatis, subcoriaceis, ovatis vel lanceolatis, apice acuminatis vel obtusis, basi in petiolum contractis, margine integerrimis; racemis simplicibus, elongatis, rare trichotomis, densifloris; pedunculis oppositis, abbreviatis, 4–8-floris; calyce æqualiter quinquepartito, pubescente; corolla infundibuliformi, extus pubescente, limbo 5-partito, laciniis ovalibus, apice acutis, 2 superioribus latioribus, labio inferiore ad faucem bullato; staminibus fertilibus 2, anantheris 2 minutis, antheris bilocularibus, loculis æqualibus, linearibus, muticis, dorso sparse hirsutis; capsula clavata, obtuse quadrangulari, sulcata.

Hab. In provincia Tenasserim, *Helfer*!; ad Moulmein, *Falconer*!, *Parish*!

Suffrutex 2–3-pedalis? *Caulis* crassus, subtetragonus. *Cortex* in parte inferiore cinereus, in juniore subincanus, pubescens. *Folia* 6–12-uncialia, 2–5 unc. lata, glaberrima, paucinervia. *Racemus* 8–12-uncialis. *Rachis* incano pubescens, pedunculis in axillis bractearum communium oppositis, abbreviatis. *Corolla* 8 lin. ad 1 unc. longa, pallide straminea, fauce maculis purpureis notata. *Capsula* immatura 8 lin. longa, sessilis, obtusa, glabra.

8. P. ELONGATUS, *T. Anders.* Caule tereti, pruinoso; foliis herbaceis, longe petiolatis, ovatis, apice acuminatis, basi in petiolo longe decurrentibus, glabris; spicis elongatis, gracilibus, plerumque terminalibus trichotome ramosis, vel axillaribus simplicibus; floribus distiche oppositis, sessilibus, solitariis; bracteis parvis, ovatis acutis, bracteolis oppositis subulatis acutis; calyce profunde 5-partito, segmentis acutis linearibus; corolla tubulosa, recta, extus pubescente, limbo bilabiatim partito, labio inferiore fauce intus hirsuto, lobis lateralibus lanceolatis acutis, intermedio latiore acuto, labio superiore obscure bifido, acuto breviore; staminibus 2, filamentis ligulatis, margine interiore barbatis, antheris bilocularibus, loculis linearibus, glabris; capsula clavata, subtetragona, glabra, octosperma, valvis sulcatis.

Hab. In provincia Martaban ad Amherst, *Falconer*!

Planta suffruticosa, 1–2-pedalis. *Folia* cum petiolo 4–6 lin. longa, 2½ unc. lata. *Spicæ* fere pedales. *Flores* sessiles, solitarii. *Bracteæ* 2 lin. longæ. *Corolla* 5 lin. longa, extus pubescens. *Capsula* clavata, apice obtusa, 8 lin. longa.

9. P. LATIFOLIUS, *Wight, Icon.* t. 1537.

Hab. In sylvis provinciæ Coorg, *Wight*!

10. P. PUBINERVIUS, *T. Anders.* Caule lignoso, subtetragono, cinereo, glabro vel pubescente; foliis petiolatis, ovatis acutis, basi breviter acuminatis, supra scabris, subtus ad costas pubescentibus; racemis simplicibus, axillaribus, oppositis, paucifloris; pedunculis subtetragonis, pubescentibus; pedicellis gracilibus, teretibus, elongatis, in portione inferiore bibracteolatis; calycis segmentis æqualibus, lineari-lanceolatis acutis, extus pubescentibus, intus incano tomentosis; corolla tubulosa, paulo incurva, extus pubescente, intus glabra, limbo quinquefido, lobis duobus superioribus inferiores superantibus; staminibus valde exsertis, filamentis ligulatis, glabris; capsula tereti, subclavata, elongata, glabra, obtusa, polysperma.

Hab. In montibus Khasiæ in sylvis subtropicis, *Simons*!, *Hook. fil.* et *T. Thoms.*!; in Assam, *Masters*!; Sikkim in sylvis subtropicis, ad altitudinem 5000 ped., *Hook. fil.*!

Suffrutex pubescens. *Cortex* cinereus. *Folia* parva, inferiora cito decidua, herbacea, 4–8 unc. longa, 1–3 unc. lata; petiolo tereti, pubescente vel tomentoso, ½–1 unc. longo. *Racemi* 6–8-flori, ex

axillis foliorum deciduorum orientes, pedunculo brevi, $\frac{1}{4}$–$\frac{1}{2}$ unc. longo, pedicellis gracilibus, pedunculo æqualibus vel longioribus. *Bracteolæ* oppositæ, minutæ, subulatæ. *Calyx* 3–4 lin. longus. *Corolla* coriacea, extus pubescens, $\frac{1}{2}$ unc. longa, 4 lin. lata, fulva?; limbi lobis incurvis, nunquam patentibus. *Capsula* sulcata, glabra, basi plus minus angusta.

XXIX. Justicia, *Linn.*

Sect. 1. Betonica. *Spicæ terminales axillaresve, bracteis imbricatis. Frutices vel suffrutices, excepta* J. montana, *cujus inflorescentia thyrsiformis est.*

1. J. montana, *Wall. Cat.* 2471.—Hemichoriste montana, *N. ab E. in Wall. Pl. As. rar.* iii. p. 102, *et DC. l. c.* p. 367.

Hab. In locis montanis Indiæ australis, ad Travancore, *Wall. Cat.* 2471 !, 2437 ! ; in provinciis Concan et Canara, *Law* !, *Gibson* !, *Stocks* ! ; in collibus Anamallay, *Beddome* !

2. J. adhatoda, *Linn. Fl. Zeyl.* p. 16.—Adhatoda vasica, *N. ab E. in Wall. l. c.* p. 103, *et DC. l. c.* p. 387.

Hab. Per totam planitiem Indicam dispersa in locis siccis vel saxosis; in Himalaya subtropica ab Assam usque ad Peshawur, *Simons* !, *Jenkins* !, *Hook. fil. et T. Thoms.* ! ; in montibus Behar et Indiæ centralis et australis; in insula Zeylania, *C. P.* 1991 ! In hort. botan. Calc. culta.

Distr. Java ! ; China !

3. J. ventricosa, *Wall. Pl. As. rar.* i. p. 80, t. 93.—Adhatoda ventricosa, *N. ab E. in DC. l. c.* p. 407.

Hab. In Burmah ad ripas fluminis Attran, *Wall. Cat.* 2436 ! ; in provincia Tenasserim ad Moulmein, *Falconer* ! In hort. bot. Calc. culta.

Distr. China.

4. J. Atkinsoni, *T. Anders.* Foliis longe petiolatis, apice et basi acuminatis, supra glabris, subtus ad costas puberulis; spicis terminalibus, elongatis, tetragonis; bracteis dense imbricatis, ovatis vel ovato-lanceolatis, apice acutis, margine ciliatis, subdentatis, utrinque pilis sparse adspersis; calycis segmentis brevibus, subulatis; corolla profunde bilabiata, tubo angusto, labio superiore subintegro, inferiore tripartito, lobis ovato-lanceolatis apice rotundatis.

Hab. In convallibus profundis tropicis provinciæ Sikkim, inter vicos Rinchingpong et Yoksun, n. 1066, *herb. Sikkimensis, T. Anders.* v. v.

Planta bracteis purpureis et spicis elongatis densis et magnitudine foliorum conspicua. *Caulis* 1–2-pedalis, debilis, basi decumbens et radicans, teres. *Folia* 6 unc. vel 1 ped. longa, late ovata, petiolo gracili, 2–3 unc. longo. *Spicæ* pedunculatæ, puberulæ, multifloræ, 6 unc. ad 1 ped. longæ. *Bracteæ* basi virides, apice et margine purpureæ. *Calyx* parvus, bracteis obtectus. *Corolla* ringens, extus pilis sparse obtecta, intus glabra, 8 lin. longa, labio superiore erecto.

I have named this species after my friend W. S. Atkinson, Esq., Director of Public Instruction in Bengal, who was my companion in a journey I made to Khanchinjunga, during which this plant was discovered.

5. J. ARGYROSTACHYA, *Wall. Cat.* 7172.—Adhatoda argyrostachya, *N. ab E. in Wall. Pl. As. rar.* iii. p. 102, *et DC. l. c.* p. 385.

Hab. Burmah in montibus prope Prome, *Wall.* !

6. J. GRANDIFOLIA, *T. Anders.* Caule subtetragono, glabro vel pubescente, foliis longe petiolatis, inæqualibus, oblique subcordatis, apice acuminatis, margine integris, utrinque glabris, nervis lateralibus basi dilatatis; spicis terminalibus et axillaribus, elongatis, pubescentibus; bracteis oppositis, laxe imbricatis, lanceolatis, apice acutis, velutinis; bracteolis linearibus acutis, tomentosis, calyce longioribus; calyce profunde 5-partito, segmentis linearibus, 3 cæteris paulo brevioribus, utrinque pubescentibus; corolla extus pubescente, intus glabra, lobis labii inferioris parvis, oblongis, obtusis; staminibus exsertis, antheris bilocularibus, loculis ovatis, glabris.

Hab. In provincia Tenasserim, *Parish*, n. 415 !

Planta herbacea, glabra. *Folia* magna, patentim nervosa, cum petiolo 10–14 unc. longa, 3–7 unc. lata. *Spicæ* debiles, laxæ, pedunculatæ, 4–10 unc. longæ. *Bracteæ* bracteolas et calycem superantes, $\frac{1}{2}$–$\frac{3}{4}$ unc. longæ. *Bracteolæ* calycem fere dimidio longiores. *Corolla* alba, purpureo maculata, 1 unc. longa.

7. J. BETONICA, *Linn. Fl. Zeyl.* p. 6.—Adhatoda betonica, *N. ab E. in Wall. Pl. As. rar.* iii. p. 103, *et DC. l. c.* p. 385.—A. variegata, *N. ab E. in DC. l. c.*—A. lupulina, *N. ab E. l. c.*—A. cheiranthifolia, *N. ab E. l. c.* p. 387.

β. Neilgherriensis, *T. Anders. in Journ. Proceed. Linn. Soc.* vii. p. 118. —A. Nilgherrica, *N. ab E. l. c.* p. 386.—A. trinervia, *N. ab E. in Wall. l. c.* p. 103, *et DC. l. c.*—A. arenaria, *N. ab E. in Wall. l. c. et DC. l. c.* p. 387.

Hab. In provinciis Concan, Malabar, et Carnatic, *Roxburgh* !, *Stocks* !, *Law* !, *Wight* !; in monte Parasnath a basi usque ad verticem, *T. Thoms.* ! *et T. Anders.*; in insula Zeylania, *Thwaites, C. P.* 385 !, 386 !, 387 ! In hort. bot. Calc. culta.

Var. β. In montibus Nilgiri ad Ootacamund, *Wight* !, *Perottet* !; ad Cochin, *Johnstone* !

Distr. Abyssinia !; Africa australis !

8. J. RAMOSISSIMA, *Roxb. Fl. Ind.* i. p. 129.—Adhatoda ramosissima, *N. ab E. in Wall. l. c.* p. 103, *et DC. l. c.* p. 385.

Hab. In Coromandel, *Roxburgh*. In hort. bot. Calc. culta.

9. J. ORIXENSIS, *Roxb. Fl. Ind.* i. p. 132.—Gendarussa Orixensis, *N. ab E. in Wall. l. c.* p. 104.—Adhatoda Orixensis, *N. ab E. in DC. l. c.* p. 400.—Justicia Tranquebariensis, *Roxb. l. c.* p. 130, *excls syn.*

Hab. In provinciis Canara et Maisor, *Law* !, *Stocks* !, *Cleghorn* !

I agree with Nees in considering Roxburgh's *J. Tranquebariensis* identical with this species. The Linnean *J. Tranquebariensis* is a very different plant, with rounded stems and axillary solitary flowers passing sometimes into pseudo-spikes at the ends of the branches. I have placed the *J. Tranquebariensis* of Linnæus in the Section GENDARUSSA.

Sect. 2. ROSTELLARIA. *Flores terminales spicati, vel axillares subsolitarii, bracteis præsertim ciliatis vel margine ciliatis; calyce 4-partito, cum rudimento laciniæ quintæ. Plantæ herbaceæ, plerumque neglectæ.*

† *Floribus terminalibus spicatis.*

10. J. PEPLOIDES, *T. Anders.*—Rostellaria peploides, *N. ab E. in Wall. l. c.* p. 101, *et DC. l. c.* p. 375.—J. procumbens, *Wall. Cat.* 2441 B. C.

β. angustifolia, *T. Anders.*—J. Vahlii, *Roth. Nov. Sp. Plant.* p. 14.—Rostellaria Vahlii, *N. ab E. in Wall. l. c.* p. 102, *et DC. l. c.* p. 376.—J. quinquangularis, *Roxb. Fl. Ind.* p. 123.—R. quinquangularis, *N. ab E. in Wall. l. c. et DC. l. c.*—J. geniculata, *Wall. Cat.* 2443.

Hab. In oryzetis et locis udis per totam Indiam a Carnatic usque ad Affghanistan, *Hamilton!*, *Roxburgh!*, *Wight!*, *Stocks!*, *Law!*, *Griffith!*, *Hook. fil. et T. Thoms.!*, *Wall. Cat.* 2441!

Var. *β*. In provinciis Carnatic, Behar, Bengal, Assam, planitie Gangetica usque ad Panjab, *Wall. Cat.* 2443 B!, *Hook. fil. et T. Thoms.!*, *Griffith!*, *Simons!*

11. J. PROCUMBENS, *Linn. Fl. Zeyl.* p. 7.—Rostellaria procumbens, *N. ab E. in Wall. l. c.* p. 101, *et DC. l. c.* p. 371.—R. hedyotifolia, *N. ab E. in Wall. l. c. et DC. l. c.*—R. crinita, *N. ab E. in Wall. l. c.* p. 101, *et DC. l. c.* p. 373.—R. mollissima, *N. ab E. in Wall. l. c. et DC. l. c.*—R. Royeniana, *N. ab E. in DC. l. c. excl. syn. Linn.*—R. sarmentosa, *Zoll. in Pl. Jav.* n. 596, *et N. ab E. in DC. l. c.* p. 370.—R. Abyssinica, *Brongn. hort. bot. Paris, et N. ab E. in DC. l. c.* p. 372, *cum syn.*—R. simplex, *Wight. Ic. Plant. Ind. Orient.* t. 1542.

Hab. In muris et rupibus necnon in sylvis siccis per totam Indiam tropicam a Zeylania usque ad Himalayam, *Hamilton!*, *Roxburgh!*, *Wall. Cat.* 2441 *partim!*, 2444 C!, 2445!, 2448!, 2449!, *Griffith!*, *Royle!*, *Hook. fil. et T. Thoms.!*, *Wight!*, *Thwaites, C. P.* 228!, 404!; in Burmah, *Wallich!*, *Falconer!*, *Brandis!* In hort. bot. Calc. culta.

Distr. Java! et insulæ Malayanæ et Philippinæ!, Siam!, Formosa!, China borealis!, Abyssinia!

Like many tropical weeds spread over a wide geographical area, this species is most protean in its character. With the assistance of a large suite of specimens, the gradations between

the extreme forms can be shown, while without the aid of such a series the limits of this species cannot be accurately determined, nor the error of raising varieties to the rank of species be avoided.

The array of synonyms I have given, is partly owing to Nees von Esenbeck's views of the limits of species, but principally to this species being at the time he wrote very imperfectly represented in the herbaria he examined. In a species so abundant as this is, scarcely any two plants are identically alike, unless growing within a short distance of each other. In the shady roadsides of Bengal, the Malayan peninsula, and Java, the plant becomes the *R. sarmentosa*, Zoll., while on the dry rocky hillsides of Southern India, Parasnath, and some portions of the Himalaya, forms are developed to which the names *R. crinita*, *R. mollissima*, and *R. rotundifolia* have been given by botanists. I believe that *R. glandulosa*, *R. adenostachya*, *R. obtusa*, and *R. media* will probably require to be added to the synonyms I have cited; but as yet I have not seen authentic specimens of these so-called species.

I find it be quite impossible even to indicate any varieties in so variable a species.

12. J. ORBICULATA, *Wall. Cat.* 2489.—Rostellaria rotundifolia, *N. ab E. in Wall. l. c.* p. 100, *et DC. l. c.* p. 370.

Hab. In provinciis Carnatic et Maisor, *Wall. Cat.* 2441 *partim*!, 2489!; in ruderatis prope Vellore, *Griffith*!; Canara, *Law*!; in Behar ad Monghir, *Hamilton in Wall. Cat.* 2441!; in planitie Gangegetica superiore ad Futteyghur, *Griffith*! In hort. bot. Calc. culta.

Distr. Java!

The name given by Wallich to this species was *J. orbiculata*, and not *J. rotundifolia*, as quoted by Nees von Esenbeck in 'Plantæ Asiaticæ rariores.' In adopting Wallich's specific name, I have merely corrected Nees's misquotation.

13. J. DIFFUSA, *Willd. Sp. Plant.* i. p. 87.—Rostellaria diffusa, *N. ab E. in Wall. Plant. As. rar.* p. 100, *et DC. l. c.* p. 371.

Hab. In Maisor et Carnatic, *G. Thomson*!, *Wight. in herb. Wall.* 2444 B!; in Orissa ad Sumbulpore, *Griffith*!; in Behar ad Monghir, *Wall. Cat.* 2444 C!; in Burmah ad ripas fluminis Attaran, *Brandis*!; in Zeylania, *C. P.* 1976!

14. J. GRACILIS, *T. Anders.*—Rostellaria gracilis, *Wight. Icon. Plant. Ind. Orient.* t. 1541.

Hab. In Canara, *Law*!

†† *Floribus axillaribus, plerumque solitariis.*

15. J. HETEROCARPA, *T. Anders. in Journ. Proceed. Linn. Soc.* vii. p. 41.
Hab. In Sind, *Stocks* !
Distr. Abyssinia !

Sect. 3. GENDARUSSA. *Flores axillares, pedunculati aggregati, vel solitarii sessiles, rarissime pseudo-spicati, bracteis parvis. Suffrutices vel plantæ lignosæ.*

† *Floribus subspicatis, axillaribus, pedunculatis.*

16. J. GENDARUSSA, *Linn. Suppl.* p. 85.—Gendarussa vulgaris, *N. ab E. in Wall. l. c.* p. 104, *et DC. l. c.* p. 410.
Hab. In provinciis Malabar, Concan, Carnatic, et Maisor, *Roxburgh* !, *Wight* !, *Stocks* !, *Law* !, *Cleghorn* ! ; in Bengal et Assam, *Griffith* !, *Masters* ! ; Khasia, *Griffith* ! ; Burmah ad ripas fluminis Attaran atque ad Amherst, *Wall. Cat.* In hort. bot. Calc. culta !
Distr. Insulæ Malayanæ et Philippinæ !, China !

17. J. HOOKERIANA, *T. Anders. in Thw. En. Pl. Zeyl.* p. 233.—Adhatoda Hookeriana, *N. ab E. in DC. l. c.* p. 403.—Leptostachya Zeylanica, *N. ab E. in DC. l. c.* p. 379, *partim.*
Hab. Ad ripas rivulorum in provincia centrali insulæ Zeylaniæ, *Thwaites, C. P.* 701 !

18. J. CEYLANICA, *T. Anders. l. c.*—Adhatoda Ceylanica, *N. ab E. in DC. l. c.* p. 400.
Hab. In insula Zeylania, *Thwaites, C. P.* 2422 !, 2718 !, 3110 !, et 713 *partim* !

†† *Floribus axillaribus, solitariis, geminis ternisve.*

19. J. TRANQUEBARIENSIS, *Linn. Suppl.* p. 85.—Gendarussa Tranbariensis, *N. ab E. in Wall. l. c.* p. 105.—Adhatoda Tranquebariensis, *N. ab E. in DC. l. c.* p. 399.
Hab. In Carnatic et Maisor, *Wight* !, *G. Thomson* ! ; in Zeylania, *Thwaites, C. P.* 1993 !

It is almost impossible to ascertain with certainty what plant Roxburgh referred to this species. The description in the 'Flora Indica' only partially agrees with this species, while the coloured drawing in the Library of the Calcutta Botanical Gardens, although named by Roxburgh *J. Tranquebariensis*, is one of *J. Orixensis*. Nees has also noticed this mistake (see the synonyms he quotes under *Adhatoda Orixensis*, DC. *l. c.* p. 400).

20. J. NEESIANA, *Wall. Cat.* 7175.—Gendarussa Neesiana, *N. ab E. in Wall. Pl. As. rar.* i. p. 105.—Adhatoda Neesiana, *N. ab E. in DC. l. c.* p. 397.
Hab. In provincia Silhet, *Wall. Cat.* 7175 !, *Griffith* ! In hort. bot. Calc. culta !

21. J. SALICIFOLIA, *T. Anders.* Caule tetragono, sulcato; foliis petiolatis, lineari-lanceolatis, apice acuminatis vel acutis; floribus ternis vel pluribus; bracteis herbaceis, petiolatis, orbiculatis; bracteolis minutis, subulatis; calyce æqualiter 5-partito, segmentis linearibus acutis; corollæ labio superiore lanceolato acuto; apice bifido; inferiore ovato, breviter trifido, intus ad faucem corrugato; capsula ovata acuta.—Adhatoda, n. 20, *Herb. Ind. of Hf. & T.*

Hab. In montibus Khasiæ prope flumen Borpanee, *Griffith,* 1278!, *Hook. fil. et T. Thoms.*!

Planta suffruticosa. Caulis debilis, subdecumbens, pilis fulvis adpressis pubescens vel cortice cinereo glaber. *Folia* supra glabra, ad costam mediam pubescentia, subtus plerumque adpresse tomentosa, raro glabra, 1–2 unc. longa; petiolo tereti, 2–4 lin. longo. *Bracteæ* 3 lin. longæ, supra glabræ, subtus tomentosæ vel raro utrinque glabræ, trinerves, apice interdum emarginatæ, petiolo 1 lin. longo. *Bracteolæ* ½ lin. longæ, subulatæ. *Calyx* bracteas æquans, segmentis æqualibus, ad dorsum et margines subciliatis. *Corolla* extus sparse pubescens, 4–5 lin. longa. *Antheræ* glabræ, loculo inferiore longe caudato. *Capsula* glabra, tetrasperma, calyce paulo longior.

This species much resembles *J. Championi*, T. Anders., in Bentham's 'Flora of Hongkong,' p. 264; indeed they differ only in the form of the leaves, which in the Chinese plant are oblong or ovate, and obtuse.

22. J. QUADRIFARIA, *Wall. Cat.* 2479.—Gendarussa quadrifaria, *N. ab E. in Wall. Pl. As. rar.* iii. p. 105.—Adhatoda quadrifaria, *N. ab E. in DC. l. c.* p. 396.—A. Zollingeriana, *N. ab E. in DC. l. c.*

Hab. In provincia Silhet, *Wall. Cat.* 2479!; in Tenasserim, *Helfer*!

Distr. Java!

23. J. BRANDISII, *T. Anders.* Caule tereti, foliis late ovatis, acutis, basi in petiolo brevi decurrentibus, nervis prominentibus approximatis; floribus interdum in pedunculo brevissimo aggregatis vel sessilibus; bracteis et bracteolis parvis, subulatis; calyce æqualiter quinquepartito; corolla tubo brevi, labio superiore breviter bifido, inferiore trifido, lobo intermedio ovato, lateralibus obtuse lanceolatis.

Hab. Burmah in montibus Toungoo, *Brandis*!; in collibus Karen, *Masson*!

Planta suffruticosa, 1–2-pedalis. *Caulis* cortice cinereo, glaber. *Folia* breviter petiolata, basi in petiolo decurrentia, supra scabriuscula, subtus sparse puberula, ad nervos pubescentia. *Calyx* incano pubescens, segmentis subulatis, 2 lin. longis. *Corolla* extus pubescens, intus glabra, bilabiata; tubo angusto, fauce corrugato. *Antheræ* loculo inferiore longe caudato. *Stigma* capitatum. *Ovarium* tetraspermum.

24. J. SALSOLOIDES, *T. Anders.* Caule ramosissimo, divaricato, tereti, incano; foliis sessilibus, parvis, spathulatis vel oblongo-lanceolatis, obtusis, subcarnosis; floribus plerumque in ramis terminalibus,

axillaribus, solitariis; bracteis parvis, lanceolatis acutis; calycis segmentis linearibus; corolla tubo brevissimo, labio superiore cucullato minute bifido, inferiore profunde trifido, lobo medio oblongo, lateralibus divergentibus ligulatis; capsula clavata, compressa, apice mucronulato, dense pubescente.

Hab. In locis, aridis provinciarum Maisor et Carnatic, *G. Thomson*!, *Wight*!

Planta divaricata, paucifoliata, incano tomentosa. *Rami* lignosi, teretes, dense tomentosi. *Folia* subglabra, 2–5 lin. longa, 1–2 lin. lata. *Calyx* 2 lin. longus, pubescens, profunde quinquepartitus. *Corolla* extus pubescens, intus glabra, 4 lin. longa, tubo 1 lin. longo. *Antheræ* subexsertæ, loculo inferiore brevi, caudato. *Capsula* 4 lin. longa, fusco tomentosa.

Sect. 4. RHAPHIDOSPORA. *Flores laxe paniculati, rarius in spicis interruptis verticillatim dispositis; corollæ tubo plus minus elongato.*

25. J. DECUSSATA, *Roxb. Fl. Ind.* i. p. 127.—Gendarussa decussata, *N. ab E. in Wall. Pl. As. rar.* iii. p. 104.—Adhatoda decussata, *N. ab E. in DC. l. c.* p. 408.—Gendarussa Sumatrana, *Miq. Flor. Ind. Bot.* ii. p. 832.

Hab. In Burmah ad Rangoon et Pegu, *Wall. Cat.* 2476!, *Cleghorn*!, *Brandis*!; in provincia Tenasserim ad Mergui, *Griffith*!; prope Moulmein, *Parish*!

Distr. Sumatra!

26. J. WYNAADENSIS, *Wall. Cat.* 2474.—Gendarussa Wynaadensis, *N. ab E. in Wall. Pl. As. rar.* iii. p. 104.—Adhatoda Wynaadensis, *N. ab E. in DC. l. c.* p. 406.

Hab. In montibus Indiæ australis, *Heyne in herb. Wall.*!; in provincia Concan, *Law*!

27. J. VASCULOSA, *Wall. Cat.* 2469.—Adhatoda vasculosa, *N. ab E. in DC. l. c.* p. 407.

Hab. In Assam, *Griffith*!; in montibus Khasiæ in sylvis tropicis, *Griffith*!, *Hook. fil. et T. Thoms.*!; in montibus Mishmee, *Griffith*!; in provincia Tenasserim, *Helfer*!, *Falconer*!

28. J. COLLINA, *T. Anders.* Caule gracili, ramoso, basi decumbente; foliis petiolatis, ovato-lanceolatis, margine integris, supra hirtellis, infra glabris, nervis pubescentibus; paniculis subterminalibus, paucifloris, gracilibus, pedunculis et pedicellis filiformibus; bracteis et bracteolis minutis, subulatis; calyce æqualiter 5-partito, laciniis linearibus; corollæ tubo elongato, apice dilatato, gradatim in faucem transeunte, limbi lobis brevibus, oblongis, labio superiore apice minute bifido; staminibus fere exsertis; capsula apice acuta, tetrasperma.—Rhaphidospora tenella, *T. Anders. in herb. Kew.*

Hab. In locis montanis provinciæ Bhotan, *Griffith*!; in sylvis densis temperatis provinciæ Sikkim ad alt. 7000 ped., *T. Anders.*

Herba debilis. *Caulis* decumbens, ad nodos radicans, infra glaber, in partibus junioribus sparse pubescens. *Folia* herbacea, cum petiolo ½–3 unc. longa, ¼–1 unc. lata. *Paniculæ* 2–5 unc. longæ. *Pedunculi* alterni, 2–5-flori, ½ unc. longi. *Pedicelli* filiformes, pedunculis multo breviores. *Corolla* glabra, recta, ¾ unc. longa. *Capsula* basi sterilis, apice fertilis, tetrasperma.

29. J. DICHOTOMA, *Blume, Bijdr.* p. 783.—Rhaphidospora dichotoma, *N. ab E. in DC. l. c.* p. 500.
Hab. In Zeylania, *Thwaites, C. P.* 2718 !, 3663 !, 713 *partim* !
Distr. Java !, insulæ Philippinæ !

30. J. GLABRA, *Kœnig in Roxb. Fl. Ind.* i. p. 130.—Rhaphidospora glabra, *N. ab E. in Wall. Pl. As. rar.* iii. p. 115, *et DC. l. c.* p. 499.
Hab. In provinciis Canara et Maisor, *Law* !; in Zeylania, *Thwaites, C. P.* 3663 !, et 713 *partim* !
Distr. Abyssinia ! var. *pubescens.*

31. J. EDGEWORTHII, *T. Anders.*—Rhaphidospora ciliata, *N. ab E. in DC. l. c.* p. 500.
Hab. In montibus Himalayæ, in Gharwal, *Royle* !; Kangra, *Edgeworth* !

Sect. 5. LEPTOSTACHYA. *Spicis trichotome ramosi; floribus sessilibus; corolla minuta, tubo brevi; antheris muticis.*

32. J. VIRGATA, *Wall. Cat.* 7177.—Leptostachya virgata, *N. ab E. in Wall. Pl. As. rar.* iii. p. 105, *et DC. l. c.* p. 379.—Adhatoda, no. 18, *Herb. Ind. Or. Hook. fil. et T. Thoms.*
Hab. In Burmah ad Taong Dong, *Wall. Cat.* 7177 !; in provincia Tenasserim, *Helfer* !; in montibus Khasiæ, *Hook. fil. et T. Thoms.* !

33. J. WALLICHII, *T. Anders.*—Leptostachya Wallichii, *N. ab E. in Wall. Pl. As. rar.* iii. p. 105, *et DC. l. c.* p. 379.—Ruellia leptostachya, *Wall. Cat.* 2411.
Hab. In montibus Nilgiri et Kurg, *Wight* ! *in herb. Wall. G. Thomson* !

34. J. GRIFFITHII, *T. Anders.* Caule basi lignoso subtereti glabro, superne herbaceo tetragono; foliis petiolatis, ovatis acutis, glaberrimis; paniculis terminalibus, trichotomis; floribus remotis, sessilibus, oppositis; bracteis et bracteolis minutis, subulatis, glabris; calyce parvo, profunde 5-fido, segmentis subulatis; corolla infundibuliformi, tubo abbreviato, limbo clauso 5-partito, lobis angustis, lobo medio labii inferioris paulo latiore, labio superiore profunde bifido; antheris muticis; ovario tetraspermo.
Hab. In collibus "Mishmee" dictis, *Griffith* !
Planta herbacea, glabra. *Caulis* erectus, tetragonus. *Folia* magna, ovata, apice acuminata, basi in petiolo decurrentia, 4–10 unc. longa, 2–4 unc. lata. *Paniculæ* terminales dichotome ramosæ, glabræ, ramis elongatis, ascendentibus. *Flores* solitarii, oppositi. *Corolla* parva

4 lin. longa, tubo ventricoso, labio superiore viridi, inferiore viridescente, rubro minute punctato. *Capsula* corolla paulo longior, apice subclavata, acuta.

Species incertæ sedis.

35. J. BOERHAAVIÆFOLIA, *T. Anders.* Caule diffuso, tereti, glabro; foliis caulinis petiolatis, ovato-lanceolatis, basi in petiolo decurrentibus, superioribus sessilibus, ovatis, basi cordatis, omnibus margine integris, supra glabris, subtus glaucis; spicis parvis, in ramis dichotomis terminalibus; bracteis subulatis, anguste albo marginatis; corolla minuta, bilabiata, extus glabra, intus ad faucem pilis recurvis bilineata; antheris superioribus, parvis, sterilibus.

Hab. In provincia Tenasserim ad Amherst, *Falconer*, n. 431!

Herba neglecta. *Caulis* herbaceus, glaber, pallidus, ramosus. *Folia* caulina longe petiolata, cum petiolo 2–5 unc. longa, superiora et floralia $\frac{1}{2}$–$1\frac{1}{4}$ unc. longa, $\frac{1}{4}$–$\frac{1}{2}$ unc. lata. *Spicæ* in pedunculis filiformibus terminalibus, secundæ, 5 lin. longæ. *Corolla* inconspicua, 2 lin. longa, fauce purpurea, rugosa. *Capsula* $1\frac{1}{2}$ ad fere 2 lin. longa, compressa, portione sterili brevissima.

36. J. PTYCHOSTOMA, *Wall. Cat.* 2478; *N. ab E. in Wall. Pl. As. rar.* iii. p. 108.—Rhytiglossa ptychostoma, *N. ab in DC. l. c.* p. 337.

Hab. In Penang, *Porter in Wall. Cat.* 2478!

XXX. PTYSSIGLOTTIS, *T. Anders.*

1. P. RADICOSA, *T. Anders. in Thwaites's En. Pl. Zeyl.* p. 235.—Rhytiglossa radicosa, *N. ab E. in DC. l. c.* p. 344.

Hab. In insula Zeylania in locis arenosis maritimis, *Champion in herb. Hook.*!, *Thwaites, C. P.* 3538.

XXXI. MONOTHECIUM, *Hochst.*

1. M. ARISTATUM, *T. Anders. in Thwaites's En. Pl. Zeyl.* p. 234.—Anthocometes aristatus, *N. ab E. in DC. l. c.* p. 312.—Justicia aristata, *Wall.* n. 2481.—J. rivinoides, *Wall. Cat.* 2488.

Hab. In montibus Nilghiri, *Wight in herb. Wall.* n. 2481!, 2488!; in insula Zeylania, *Thwaites, C. P.* 1984!

XXXII. RUNGIA, *N. ab E.*

1. R. LINIFOLIA, *N. ab E. in Wall. Pl. As rar.* iii. p. 110, et *DC. l. c.* p. 469.—Justicia linifolia, *Heyne in Wall. Cat.* 2447.

Hab. In provincia Concan, *Stocks*!

2. R. LONGIFOLIA, *N. ab E. in DC. l. c.* p. 471.

Hab. In insula Zeylania, *Thwaites, C. P.* 257!, 89 *partim*!

3. R. PECTINATA, *N. ab E. in DC. l. c.* p. 470.—Justicia pectinata, *Linn. in Amœn. Acad.* iv. p. 299.—Rungia parviflora, *N. ab E. in*

Wall. Pl. As. rar. iii. p. 110, *et DC. l. c.* p. 469.—R. muralis, *Royle, N. ab E. in DC. l. c.* p. 470.—R. polygonoides, *N. ab E. in Wall. l. c. et DC. l. c.* p. 471.—R. origanoides, *N. ab E. in Wall. et DC. l. c.*

Hab. Per totam Indiam tropicam diffusa; in Bengalia et planitie Gangetica, *Roxburgh*!, *Hook. fil. et T. Thoms.*!, *T. Anders.*; Behar, *T. Thomson*!, *Jerdon*!; Concan, *Stocks*!, *Law*!; in Burmah, *Griffith*!; ad Rangoon, *T. Anders.*!; in insulis Andaman, *Helfer*!; in Zeylania, *C. P.* 1975!, 3354!, 3357!

4. R. REPENS, *N. ab E. in Wall. l. c.* p. 110, *et DC. l. c.* p. 472.—Justicia repens, *Linn. Sp. Pl.* p. 15.

Hab. In India orientali a Zeylania usque ad basin montium Himalayæ præsertim in locis humidis et umbrosis; in planitie Gangetica superiore ad Futtyghur, *T. Anders.*; prope Sagur in India centrali, *Jerdon*!; in provinciis Malabar, Canara et Concan, *Stocks*!, *Law*!; in montibus Nilgiri ad Sispara, *Beddome*!

5. R. LATIOR, *N. ab E. in DC. l. c.* p. 472!

Hab. In montibus Nilgiri, ad alt. 6000 ped., *Beddome*!; in collibus Anamallay, alt. 4500 ped., *Beddome*!; in Zeylania, *Thwaites, C. P.* 89 *partim*!; ad Maturata et Hangoram, *T. Thomson*!

6. R. WIGHTIANA, *N. ab E. in Wall. Pl. As. rar.* iii. p. 110, *et DC. l. c.* p. 472.—Justicia Wightiana, *Wall. Cat.* 2472.

Hab. In provinciis Carnatic et Courtallum, *Wight*! *in Wall. Cat.* 2472!

7. R. CRENATA, *T. Anders.* Caule diffuso, repente tetragono, ad nodos radicante; spicis axillaribus, sessilibus, villosis; bracteis majoribus vacuis, herbaceis, lanceolatis, apice mucronulatis, marginibus herbaceis; bracteis floriferis fere orbiculatis, apice cuspidatis, margine late membranaceis; capsula parva, pubescente.

Hab. In montibus Canara, *Law*!

Caulis elongatus, debilis, pedalis; cortice pallido, glabro. *Folia* ignota. *Spicæ* axillares et terminales, simplices vel dichotome ramosæ, $\frac{1}{2}$–1 unc. longæ. *Bracteæ vacuæ* posteriores, patentes, imbricatæ, omnino herbaceæ, 2–3 lin. longæ. *Bracteæ floriferæ* vacuis dimidio breviores, 1 lin. longæ. *Calyx* chartaceus, quinquefidus, segmentis linearibus.

8. R. SISPARENSIS, *T. Anders.*—Adhatoda Sisparensis, *Benth. in Scheda Hohenacker, Plant. Ind. Or.* n. 1436.

Hab. In montibus Nilgiri ad Sispara, *Wight*!; in montibus Anamallay, *Beddome*!

9. R. PUNDUANA, *N. ab E. in Wall. Pl. As. rar.* iii. p. 110, *et DC. l. c.* p. 473.—Justicia Punduana, *Wall. Cat.* 2453.

Hab. In montibus Khasiæ, *Wall. Cat.* 2453!, *Griffith*!

10. R. KHASIANA, *T. Anders.* Caule fruticoso, erecto, foliis petiolatis, ovatis, supra glabris, subtus ad nervos tomentosis; spicis axil-

laribus terminalibusque; bracteis ovatis, apice mucronulatis, margine anguste membranaceo, hyalinis, minute puberulis; bracteolis linearibus vel lanceolatis acutis; calyce parvo, profunde æqualiter 5-fido, membranaceo, glabro; capsula glabra.

Hab. In montibus Khasiæ, *Griffith*!

Caulis 1–2-pedalis, ad angulos pubescens. *Folia* petiolo abrupte conjuncta, basi obliqua, cum petiolo 2–4 unc. longa, 1–1½ unc. lata; petiolo tomentoso. *Spicæ* brevissime pedunculatæ, 1 unc. longæ. *Bracteæ* herbaceæ, margine vix hyalino-membranaceo, 5 lin. longæ. *Bracteolæ* calycem excedentes, extus puberulæ, intus glabræ. *Calyx* vix 2 lin. longus.

11. R. Mastersi, *T. Anders.* Caule herbaceo, erecto, infra nodos tumido, minute lineolato; foliis longe petiolatis, ovatis; spicis terminalibus ternis vel subpaniculatim ramosis, pedunculatis, laxis; bracteis remotis, alternis, spathulato-linearibus, apice obtusis, bracteolis ovatis, acutis, glumaceis; calyce inæqualiter diviso, bracteis et bracteolis breviore; corolla parva, labio superiore anguste lanceolato, apice obtuso, inferiore lobo medio fere rotundato, lateralibus angustioribus; capsula parva, pubescente.

Hab. In Assam ad ripas fluminis Soonder, *Masters*!

Planta herbacea, glabra, cæteris speciebus elatior. *Rami* elongati, ascendentes. *Folia* tenuia, minute lineolata, pagina inferiore pallida, cum petiolo 5–8 unc. longa, 1½–2 unc. lata. *Spicæ* glabræ vel pubescentes, plus minus secundæ, 3–6 unc. longæ. *Bracteæ* et *bracteolæ* plerumque lineares, obtusæ, glabræ, 2 lin. longæ, ½ lin. latæ. *Corolla* 4 lin. longa, glabra. *Capsula* sparse puberula, apice mucronulata, 3 lin. longa.

XXXIII. Dicliptera, *Juss.*

1. D. bivalvis, *Juss. Ann. du Mus.* ix. p. 268; *N. ab E. in DC. l. c.* p. 475.—D. Zeylanica, *N. ab E. in DC. l. c.* p. 474.

Hab. In umbrosis regionum siccarum Indiæ australis et Zeylaniæ: ad Courtallum, *Wight*!; in Carnatic, *Beddome*!; Concan et Maisor, *Stocks*!, *Law*!, *Gibson*!; in Zeylania, *Thwaites. C. P.* 399!, 2576!

2. D. Roxburghii, *N. ab E. in Wall. Pl. As. rar.* iii. p. 111, *et DC. l. c.* p. 483, *excl. syn.*—D. bupleuroides, *N. ab E. in Wall. l. c.* p. 485.—Justicia latebrosa, *Roxb. Fl. Ind.* i. p. 125?—D. hirtula, *N. ab E. in DC. l. c.* p. 485.—Justicia canescens, *Wall. Cat.* 2423.

Hab. In Bengal ad Sumbulpore, *Griffith*!; Behar ad radices montis Parasnath, *T. Thomson et T. Anders.*!; Assam, *Griffith*!, *Jenkins*!, *Masters*!; in Bengalia orientali ad Silhet, *Wall. Cat.* 2466 D!, *Griffith*!; in planitie Gangetica superiore, *T. Thomson*!, *Royle*!; in Panjab, *Stewart*!, *Clark*!, *Parish*!; in Himalaya tropica a Sikkim usque ad Kashmir; Sikkim, *T. Thomson*!, *T. Anders.*; in Nepal, *Wall. Cat.* 2423!; Kumaon, *T. Thoms.*!, *T. Anders.*; Sirmoor, *Gerard in*

herb. Wall. 2466 F!; Hazara, *Stewart*!; in regione Coromandel, *Heyne in Wall. Cat.* 2466!

Distr. Affghanistan!

In the 'Flora of Hongkong' I agreed with Mr. Bentham in regarding *D. Chinensis*, *D. Burmanni*, and *D. Roxburhii* as one species. This arose partly from the confusion Nees had made among the specimens of these species, and from the rarity of authentic specimens of the true *D. Burmanni*. I have lately had ample material for clearing up the uncertainty about these three species, and I now see that they are distinct. *Dicliptera chinensis*, Juss. (*Justicia Chinensis*, Linn.), is cultivated in the Calcutta Botanical Gardens, and, besides, has for many years been a weed in many parts of the garden; it was sent to the gardens in 1809 from China by Mr. Kerr. Specimens of this plant occur in several Indian herbaria, such as Wallich's, Griffith's, Masters's; and Nees has recorded the locality of some of these specimens, as Khasia and Assam, where the plant is quite unknown. The Java species, *D. Burmanni*, is an erect strongly growing plant, very different from the weak trailing *D. Chinensis* in habit, as well as in the botanical characters of the leaves, bracts, calyx, and corolla. It also grows in the Botanical Gardens most luxuriantly; it was introduced from the Botanical Garden of Buitenzorg, in Java, about three years ago. It is certainly Burmann's plant, although his figure of it is bad. The common Indian *D. Roxburghii* is very distinct from either of these species. The state of it called *D. bupleuroides* by Nees is figured by Roxburgh in the drawings in the library of the Calcutta Botanical Gardens; the drawings are on the same sheet, and by the side of a very accurate representation of the Chinese plant, from which, in the 'Flora Indica,' he suggests they are perhaps distinct. Besides the cultivated plants of *D. Chinensis* and *D. Burmanni* in the Garden, I possess specimens of them from China and Java, sent to me by Dr. Hance and Mr. Teijsmann; I have also an extensive series of Indian specimens of *D. Roxburghii*. It is probable that *D. Roxburghii* is confined to India, while the nearly allied *D. Chinensis* seems to be found only in China, and perhaps in the Philippine Islands. The very distinct *D. Burmanni* is apparently a very local Javan species.

3. D. RIPARIA, *N. ab E. in Wall. Pl. As. rar.* iii. p. 112, *et DC. l. c.* p. 480.

Hab. In Burmah, in collibus prope Prome, infra Melloon, *Wall. Cat.* 7183!; Pegu, *Brandis*!; Moulmein, *Falconer*!; Rangoon, *Cleghorn*!; prope Meaday, *Scott*!

4. D. CUNEATA, *N. ab E. in Wall. Pl. As. rar.* iii. p. 111, *et DC. l. c.* p. 481.—Justicia umbellata, *Wall. Cat.* 2467.
Hab. In provincia Carnatic ad Travancore, *Wall. Cat.* 2467 !, *herb. Hook. fil. et T. Thoms.* !, *Cleghorn*! ; in provincia Concan, *Stocks* !, *Law* !, *Gibson* !

5. D. MICRANTHES, *N. ab E. in Wall. Pl. As. rar.* iii. p. 112, *et DC. l. c.* p. 484.—D. spinulosa, *Hochst. in Schimp. Pl. Abyss.* n. 509.
Hab. In pratis aridis Behar, *Hook. fil. et T. Thoms.* !, *T. Anders.* ; Malwah ad Sagur, *Jerdon* ! ; Rohilcund, *T. Thomson* !

XXXIV. PERISTROPHE, *N. ab E.*

1. P. BICALYCULATA, *N. ab E. in Wall. Pl. As. rar.* iii. p. 113, *DC. l. c.* p. 496, *cum syn.*
Hab. In sepibus et locis ruderatis per totam Indiam orientalem : in Concan et Kurg, *Wall. Cat.* 2457 !, *Stocks* !, *Law* !, *Wight* ! ; in India centrali ad Sagur, *Jerdon* ! ; Behar, *Hook. fil. et T. Thoms.* !, *T. Anders.* ; in planitie Gangetica superiore et Panjab, *Wall. Cat.* 2457 !, *Hook. fil. et T. Thoms.* !, *T. Anders.* ; in Burmah ad Prome, *Wall. Cat.* 2457. In hort. bot. Calcutt. indigena.
Distr. Arabia !, Abyssinia !, Africa centralis !, Senegambia !, insulæ Capitis Viridis !

2. P. SPECIOSA, *N. ab E. in Wall. Pl. As. rar.* iii. p. 113, *et DC. l. c.* p. 495.—Justicia speciosa, *Roxb. Fl. Ind.* i. p. 122.
Hab. In sylvis montanis tropicis, Sylhet, *Wall. Cat.* 2464 ! ; Bhotan prope Dewangiri, *Simons* ! ; Sikkim, *Hook. fil, et T. Thoms.* ! ; in Nipal, *Wall. Cat.* 2464 ! In hort. botan. Calcutt. culta !

3. P. TINCTORIA, *N. ab E. Wall. Pl. As. rar.* iii. p. 113.—Justicia tinctoria, *Roxb. Fl. Ind.* i. p. 123.
Hab. In Bengalia ad Rungpore, *Hamilton in Wall. Cat.* 2465 ! ; in Assam, *Masters* !, *Simons* ! ; in montibus Khasiæ *Griffith* ! ; in Zeylania, *Walker in herb. Hook.* ! In hort. botan. Calcutt. culta !

4. P. MONTANA, *N. ab E. in Wall. Pl. As. rar.* iii. p. 113, *et DC. l. c.* p. 493, *cum var.*—Justicia montana, *Wall. Cat.* 2471 !—J. sylvestris, *Wall. Cat.* 2468 !
Hab. In montibus Khasia, *Griffith* !, *Hook. fil. et T. Thoms.* ! ; Assam, *Jenkins* ! ; ad Travancore et Courtallum, *Wall. Cat.* 2468 ! et 2471 ! ; Malabar et Concan, *Stocks* !, *Law* ! ; in montibus Anamallay, *Beddome* !

5. P. ACUMINATA, *N. ab E. in Wall. Pl. As. rar.* iii. p. 113, *DC. l. c.* p. 496, *cum var.*
Hab. In montibus Khasiæ prope Silhet, *Wall. Cat.* 2425 ! ; in provincia Tenasserim ad Tavoy, *Wall. Cat.* 2425 ! ; ad Moulmein, *Falconer* !, n. 403 ! ; in peninsula Malayana ad Malacca, *Griffith* !

6. P. fragilis, *N. ab E. in Wall. Pl. As. rar.* iii. p. 113, *DC. l. c.* p. 495.

Hab. In provincia Tenasserim ad Tavoy, *Wall. Cat.* 7184!; Moulmein, *Parish*, 324! "Flores lilacini" (*Parish*).

7. P. lanceolaria, *N. ab E. in Wall. Pl. As. rar.* iii. p. 114, *DC. l. c.* p. 496.—Justicia lanceolaria, *Roxb. Fl. Ind.* i. p. 121.

Hab. In Sylhet, *Wall. Cat.* 2463!, *Hook. fil. et T. Thoms.*!; in provincia Tenasserim, *Helfer*!; ad Moulmein, *Parish*, 405!

I have seen only a leaf of *Peristrophe pubigera*, N. ab E.; and from this fragment it is impossible to form any opinion regarding the species. It appears from Nees von Esenbeck's description to be distinct from the other species of *Peristrophe*.

XXXV. Hypoestes, *R. Br.*

1. H. lanata, *Dalz. in Hook. Journ.* ii. p. 343.

Hab. In sylvis umbrosis Concanensibus, *Dalzell*!, *Stocks*!, *Gibson*!

2. H. Malaccensis, *Wight, Ic.* t. 1555.

Hab. In peninsula Malayana ad Malacca, *Capt. A. C. Wight*!

3. H. triflora, *Rœm. et Sch. Syst.* i. p. 88; *N. ab E. in DC. l. c.* p. 506.

Hab. In Nipal, *Wall. Cat.* 2466 e!; in valle profunda calida provinciæ Sikkim "Ratong" dicta, *T. Thomson*!, *T. Anders.*, 1063 *herb. Sikkim*; Assam, *Masters*!

Hypoestes purpurea is nowhere indigenous in India; the specimens which Nees von Esenbeck supposed to be from Assam were collected in the Calcutta Botanical Gardens, where this species is cultivated.

XXXVI. Rhinacanthus, *N. ab E.*

1. R. communis, *N. ab E. in Wall. Pl. As. rar.* iii. p. 109, *et DC. l. c.* p. 442.—Justicia nasuta, *Linn. Sp. Pl.* p. 16.—R. osmospermus, *N. ab E. in DC. l. c.* p. 443.—R. Rottlerianus, *N. ab E. l. c.*

Hab. In sylvis montanis siccis provinciarum Carnatic, *Wall. Cat.* 2440!, 2477!, *Hook. fil. et T. Thoms.*!; et Malabar et Concan, *Stocks*!, *Law*!; in Orissa, *Griffith*!; Behar, *Hook. fil. et T. Thoms.*!; in Zeylania, *C. P.* 1982!, *T. Thomson*!; Burmah in montibus prope Prome, *Wall. Cat.* 2440!; ad montem Puejo, *Brandis*! In hort. botan. Calcutt. cultus.

Distr. Java!, Madagascar!

2. R. calcaratus, *N. ab E. in DC. l. c.* p. 444.—Justicia calcarata, *Wall. Pl. As. rar.* ii. p. 9, t. 113.

Hab. In montibus Khasiæ prope Silhet, *Wall. Cat.* 2426!, *Griffith*!

XXXVII. Graptophyllum, *N. ab E.*

1. G. hortense, *N. ab E. in Wall. Pl. As. rar.* iii. 285, *et DC. l. c.* p. 328.

Var. *α. foliis viridibus albo variegatis.*

Var. *β. foliis ferrugineis immaculatis.*

Var. *γ. foliis ferrugineis albo variegatis.*

Hab. Per totam Indiam, Zeylaniam, et regnum Burmannicum in hortis cultum, *Wall. Cat.* 2438!

Distr. Patria ignota, sed per totum orbem tropicum ob flores speciosos et folia pulchra cultum; in insulis Amicis et Vitiensibus forsan indigena.

XXXVIII. Eranthemum, *Linn.*

1. E. ecbolium, *T. Anders. in Thwaites's En. Pl. Zeyl.* p. 235.—Justicia ecbolium, *Linn. Sp. Pl.* 15, et *N. ab E. in DC. l. c.* p. 426.—J. gymnostachya, *N. ab E. in DC. l. c.* p. 426.—J. lactevirens, *Vahl, En.* i. p. 118.—J. strobilifera, *Lam. Ill.* i. p. 36.—J. emarginata, *N. ab E. in DC. l. c.* p. 427.—J. rotundifolia, *N. ab E. in Wall. Pl. As. rar.* iii. p. 108, *et DC. l. c.*—J. syringæfolia, *Vahl, En.* i. p. 117, *N. ab E. in DC. l. c.*—J. livida, *Wall. Cat.* 2482, *N. ab E. in DC. l. c.*—J. dentata, *Klein, N. ab E. in DC. l. c.*

Hab. In regionibus montanis Indiæ australis et Zeylaniæ atque in peninsula Malayana; in provinciis Carnatic et Concan, *Wall. Cat.* 2432!, *Stocks*!, *Law*!, *Wight*!, *Beddome*!; in Zeylania, *C. P.* 1978!; in Assam, *Masters*!, *Griffith*!, *Jenkins*!, *Hamilton in herb. Wall.* 2432!; Malacca, *Maingay*! In horto botanico Calcuttensi cultum.

Distr. Muscat, Arabia Felix, Abyssinia!, Madagascar!

2. E. crenulatum, *Wall. in Bot. Reg.* t. 879; *N. ab E. in DC. l. c.* p. 453, *cum var.*

Hab. In provinciis Malabar et Concan, *Stocks*!, *Law*!, *Gibson*!, *Heyne ex Wall. Cat.* 2491!; in provincia Tenasserim ad Amherst, *Wall. Cat.* 2491!; Malacca, *Griffith*!; in insula Zeylania, *Thwaites, C. P.* 1703!, 1979!, *Watson*!, *T. Thomson*! In horto botanico Calcutt. cultum!

Distr. Java!

3. E. Blumei, *Teijsm. in Miq. Flor. Ind. Bat.* ii. p. 836.

Hab. In peninsula Malayana ad Singapore, *T. Anders.* n. 112. In hort. botan. Calcutt. cultum.

Distr. Sumatra!

4. E. album, *N. ab E. in DC. l. c.* p. 455.—Justicia alba, *Roxb. Fl. Ind.* i. p. 116.

Hab. In Burmah ad Rangoon, *Cleghorn*!; Pegu, *Brandis*!; in insulis Andaman, *Roxburgh*!, *Haughton*! In horto botanico Calcuttensi cultum.

5. E. PALATIFERUM, *N. ab E. in Wall. Pl. As. rar.* iii. p. 108; *DC. l. c.* p. 457.—Justicia palatifera, *Wall. Pl. As. rar.* i. p. 80, t. 92.
Hab. In montibus Khasiæ, *Wallich* !, *Griffith* !; in Assam, *Masters* !, *Simons* !, *Jenkins* !

6. E. CINNABARINUM, *Wall. Pl. As. rar.* i. p. 20, t. 21; *N. ab E. in DC. l. c.* p. 453.
Hab. In provincia Tenasserim, *Wallich* !, *Parish* ! In horto botan. Calcutt. cultum !

XXXIX. CODONACANTHUS, *N. ab E.*

1. C. PAUCIFLORUS, *N. ab E. in DC. l. c.* p. 103.—C. acuminatus, *N. ab E. l. c.*—Asystasia pauciflora, *N. ab E. in Wall. Pl. As. rar.* p. 90. —Ruellia pauciflora, *Wall. Cat.* 2369.
Hab. In montibus Khasiæ et Assam, *Wall. Cat.* 2369 !, *Masters, Simons* !, *Jenkins* !, *Hook. fil. et T. Thoms.* !; in collibus Mishmi, *Griffith* !
Distr. Hongkong !

XL. ASYSTASIA, *Blume.*

1. A. MYSURENSIS, *T. Anders.*—Ruellia Mysurensis, *Roth. Nov. Pl. Sp.* p. 303.—Strobilanthes Mysurensis, *N. ab E. in Wall. Pl. As. rar.* iii. p. 86, *et DC. l. c.* p. 192.—Asystasia Lawiana, *Dalz. in Hook. Journ. of Botany*, iv. p. 344.
Hab. In Canara, *Heyne ex Wall. Cat.* 2492 !, *Law* !, *Gibson* !; in montibus Nilgiri et Kurg, *G. Thomson* !; in collibus Anamallay, *Beddome* !; in Malwah prope Sagur, *Jerdon* !

2. A. LANCEOLATA, *T. Anders.* Caule subtereti; foliis breviter petiolatis, lanceolatis, acuminatis, utrinque glabris; spicis terminalibus; floribus sessilibus, oppositis, solitariis vel binis; bracteis lanceolatis acutis, calycem æquantibus, villosis; calycis laciniis æqualibus, linearibus; corolla infundibuliformi, tubo brevi, angusto, parte infundibuliformi elongata, limbo parvo, inæqualiter 5-lobo; antheris bilocularibus, loculis basi mucronatis.
Hab. In Burmah ad Baragyn, *Brandis* !
Planta herbacea, erecta, glabra. *Caulis* parce ramosus, nodis remotis. *Folia* breviter petiolata, lanceolata, margine undulata, paucinervia, 4–6 unc. longa, $1\frac{1}{2}$ unc. lata. *Spicæ* terminales, erectæ. *Flores* in axillis bractearum, solitarii vel bini. *Bracteæ* subherbaceæ, laxæ, decussatim oppositæ, paulo remotæ, 3 lin. longæ. *Calyx* bracteis æqualis, membranaceus, villosus. *Corolla* infundibuliformis, extus villosa, fere 1 unc. longa, limbi lobis parvis, erectis.

3. A. NEMORUM, *N. ab E. in Wall. Pl. As. rar.* iii. p. 90, *et DC. l. c.* p. 167.—Ruellia nemorum, *Wall. Cat.* 2399 c.—R. secunda, *Wall. Cat.* 2401.

Var. β. angustifolia, *Thwaites*; foliis lanceolatis vel linearibus.

Hab. In Carnatic, *Wall. Cat.* 2399 c!, 2401!

β. In montibus Anamallay, *Beddome*!; in Zeylania, *C. P.* 552! In hort. botan. Calcutt. culta!

Distr. Java!

In Thwaites's 'Enumeration of Ceylon Plants,' I united this species with *A. chelonoides*. I am now convinced that they are perfectly distinct species. I have for some time cultivated plants of both species from Ceylon and Java. *A. nemorum* has smaller and differently marked flowers, shorter pedicels, and smaller capsules than *A. chelonoides*, and, besides, is somewhat procumbent in habit.

4. A. CHELONOIDES, *N. ab E. in Wall. Pl. As. rar.* iii. p. 89, *et DC. l. c.* p. 164.—Ruellia chelonoides, *Wall. Cat.* 2335.

Hab. In montibus provinciarum Concan et Kurg, *Wight in herb. Wall.* 2335!, *Stocks*!, *Law*!, *Gibson*!; in insula Zeylania, *Thwaites, C. P.* 1989!

5. A. GANGETICA, *T. Anders. in Thwaites's En. Pl. Zeyl.* p. 235, *cum syn.*—Justicia Gangetica, *Linn. Amœn. Acad.* iv. p. 299.—A. Coromandeliana, *auct.*

Var. β. flore albo.

Hab. In regionibus calidis Indiæ orientalis, præsertim in provinciis Concan, Malabar, Carnatic, Orissa, Bengal, *Wall. Cat.* 2399!, *Rottler in herb. Hornemann*!, *Hook. fil. et T. Thoms.*!, *Stocks*!, *Law*!; in peninsula Malayana ad Singapore, *T. Anders.*; in insula Zeylania, *C. P.* 1998! In hort. botan. Calcutt. indigena et cult.

β. In hort. bot. indigena.

Dist. Java!, Arabia!, Africa ad oram occidentalem in Africa australi!, Abyssinia!, Madagascar!

6. A. MACROCARPA, *N. ab E. in Wall. Pl. As. rar.* iii. p. 89, *et DC. l. c.* p. 163.—Ruellia macrocarpa, *Wall. Cat.* 2348!

Hab. In locis udis ad ripas fluminum jugi montium Himalayæ; in Nepal, *Wall. Cat.* 2348!; Sikkim, *Hook. fil. et T. Thomson*!; ad ripas fluminis Rungeet, *T. Thoms.*!

7. A. THYRSACANTHUS, *T. Anders.*—Thyrsacanthus indicus, *N. ab E. in DC. l. c.* p. 325.

Hab. In sylvis densis subtropicis jugi montium Himalayæ; in provinciis Sikkim et Bhotan, *Griffith*! *Hook. fil. et T. Thoms.*!, *T. Anders.*; in montibus Khasiæ, *Griffith*!

8. A. KUNTHIANA, *N. ab E. in Wall. Pl. As. rar.* iii. p. 89, *et DC. l. c.* p. 163.—Ruellia Kunthiana, *Wall. Cat.* 2419.

Hab. In Penang, *Wall. Cat.* 2419.

9. A. NEESIANA, *N. ab E. in Wall. Pl. As. rar.* iii. p. 89, *et DC. l. c.* p. 164.—Ruellia Neesiana, *Wall. Pl. As. rar.* i. p. 73. t. 83.

Var. β. minor.

Hab. In montibus Khasiæ, *Wall. Cat.* 2342 !, *Griffith* !, *Masters* ! *Hook. fil. et T. Thoms.* ! ; in provincia Tenasserim ad Moulmein et prope Pegu, *Scott* ! ; in montibus Nat-tong, *Cross* !

Var. *minor*. In montibus Khasiæ, *Masters* !

10. A. PARISHII, *T. Anders.*—Eranthemum crenulatum, var. grandiflorum, *Hook. Bot. Mag.* t. 5440, *excl. syn.*

Hab. In provincia Tenasserim, *Parish*, 409 !

11. A. ATROVIRIDIS, *T. Anders.* Caule tetragono, glabro; foliis caulinis longe petiolatis, ovatis, in petiolo decurrentibus, apice acuminatis, margine integris, utrinque glabris; spicis terminalibus ebracteatis, subsecundis; floribus breviter pedicellatis; calyce profunde 5-fido, laciniis subulatis; corolla glabra, tubo elongato, angusto, fauce dilatato, limbo subcampanulato, lobis subæqualibus, ovatis; staminibus inclusis, antheris basi indistincte mucronatis.—Ruellia atroviridis, *Wall. Cat.* 2404.—Verbenacearum species, *N. ab E. in DC. l. c.* p. 155.

Hab. In montibus Silhet, *Bruce in Wall. herb.* 2404 ! ; in montibus Khasiæ ad Mahadeb, *Griffith* ! *Hook. fil. et T. Thomson*, Asystasia, n. 15.

Planta suffruticosa. *Caulis* trichotome ramosus. *Folia* 3–10 unc. longa, petiolo foliorum caulinorum 3 unc. longo; folia floralia sessilia. *Spicæ* laxæ, erectæ, glabræ, 2–3 unc. longæ. *Flores* oppositi vel subsecundi; pedicelli 1–2 lin. longi, medio minute bibracteati. *Corolla* glabra, paulo curvata, 2–2½ unc. longa.

12. A. CRISPATA, *Benth. in Linnæa*, xxiv. p. 647.

Hab. In Travancore ad Cochin, *Johnstone* ! ; in montibus Nilgiri, *Hohenacker* !

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THE END.

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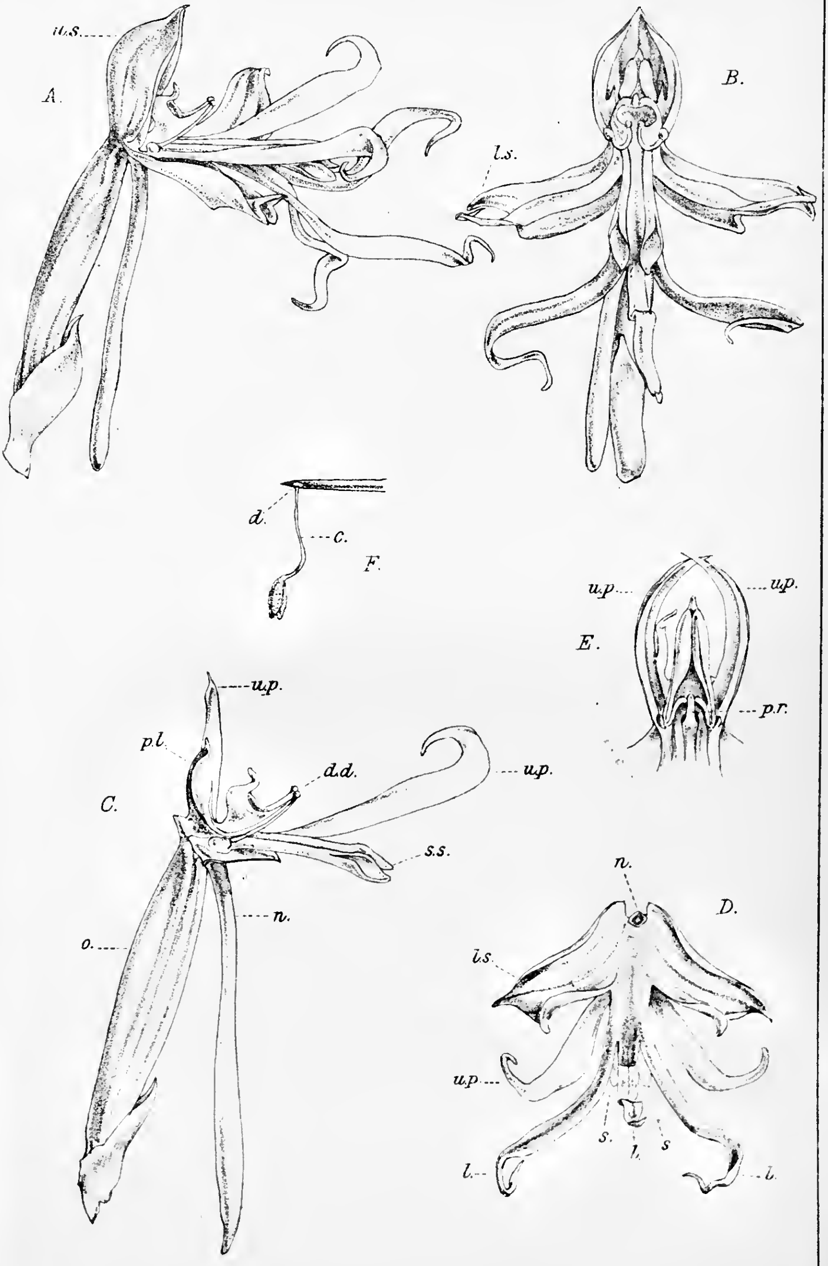

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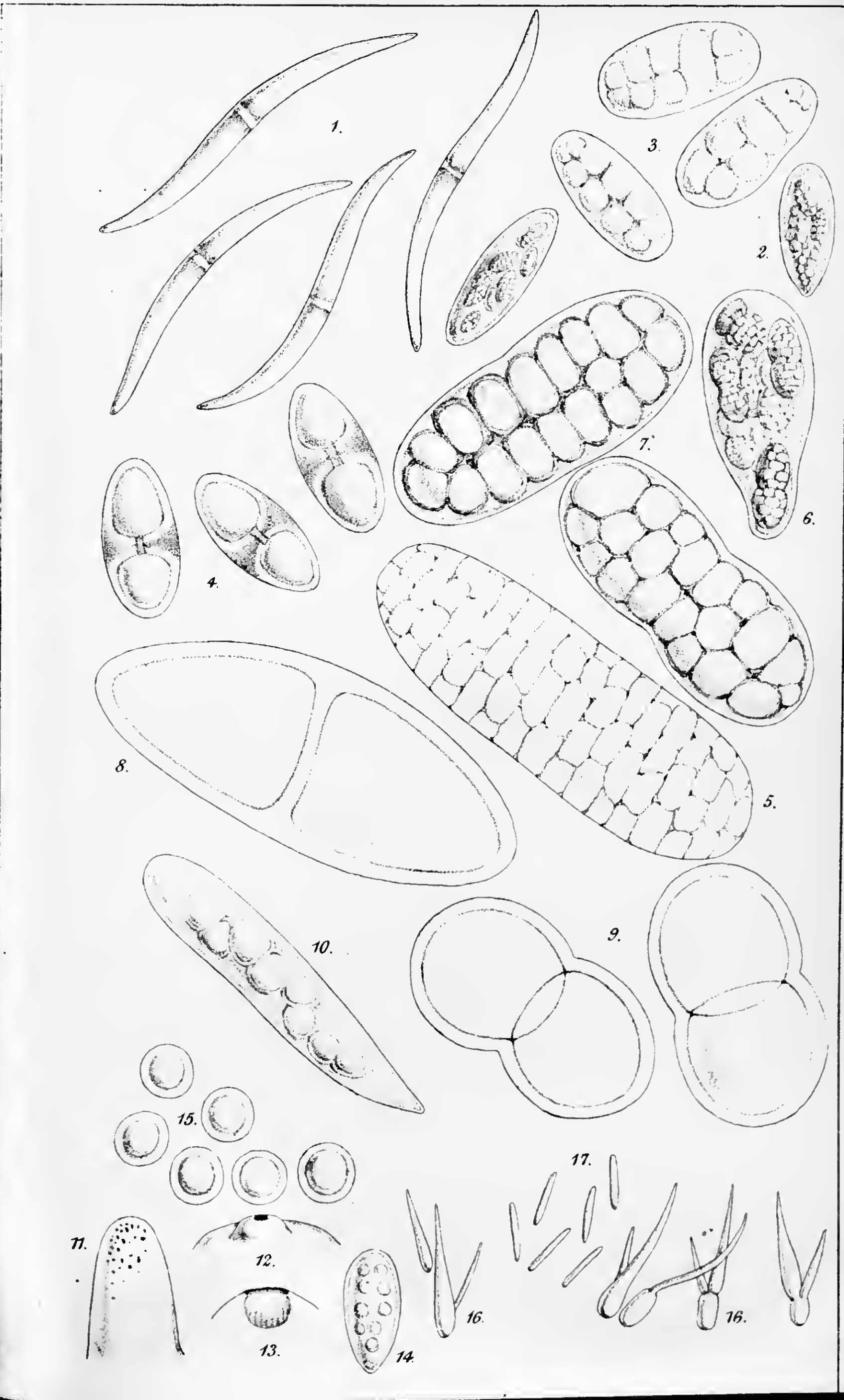
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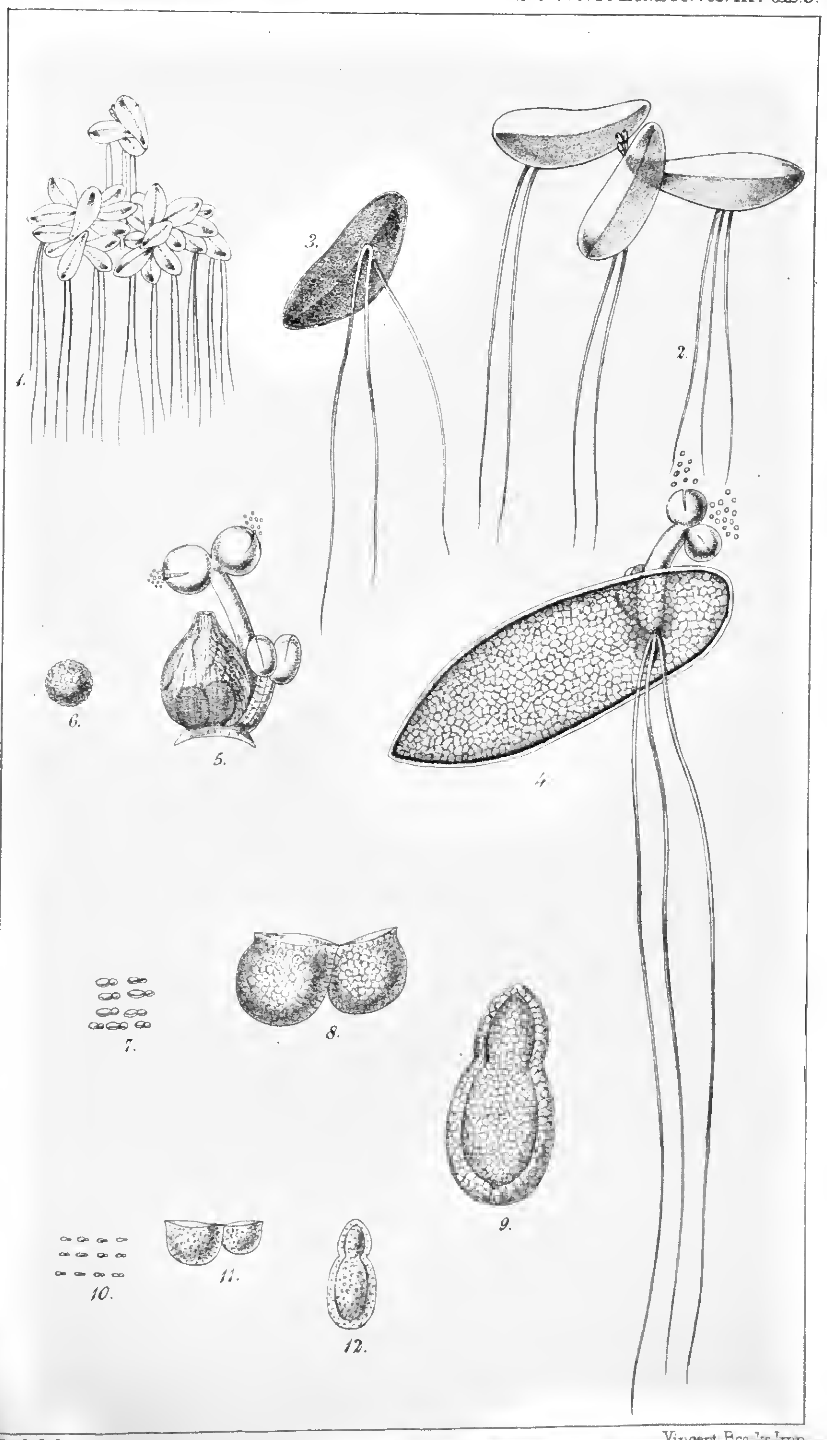

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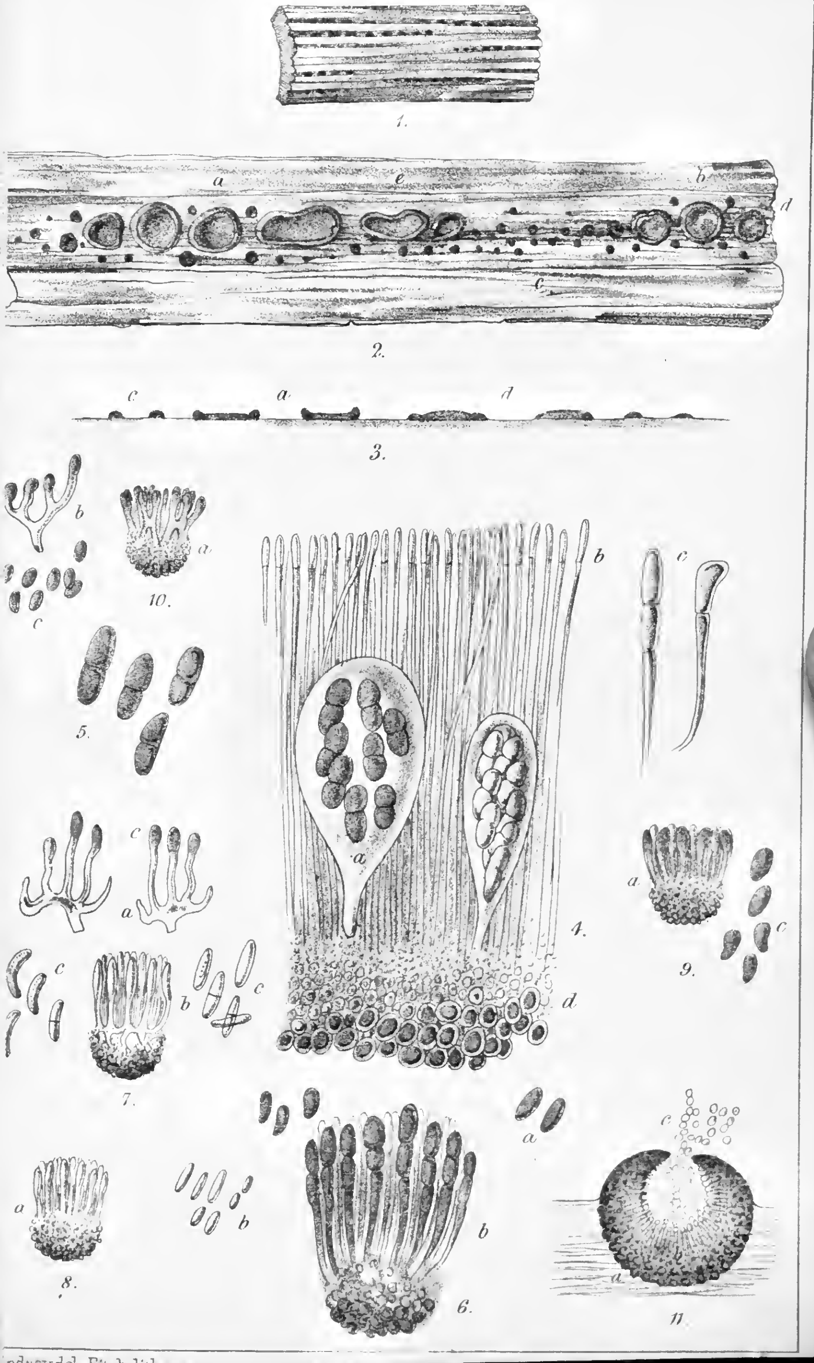

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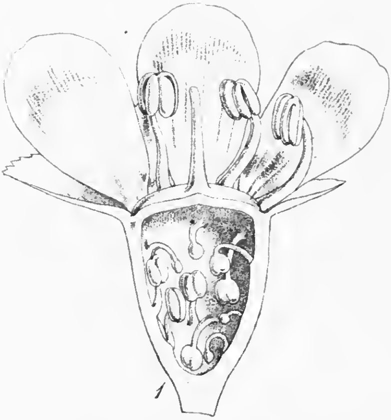

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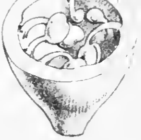

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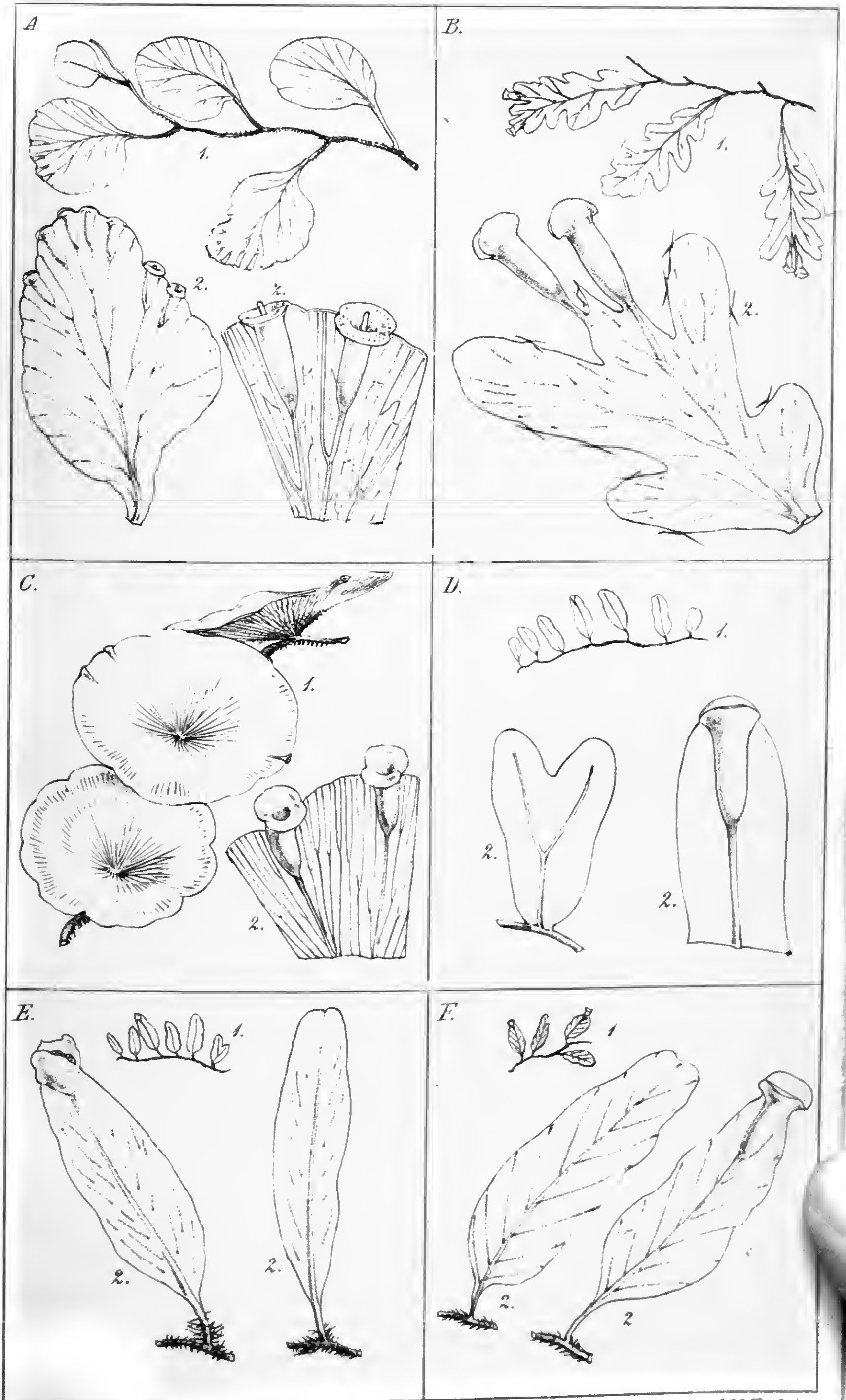

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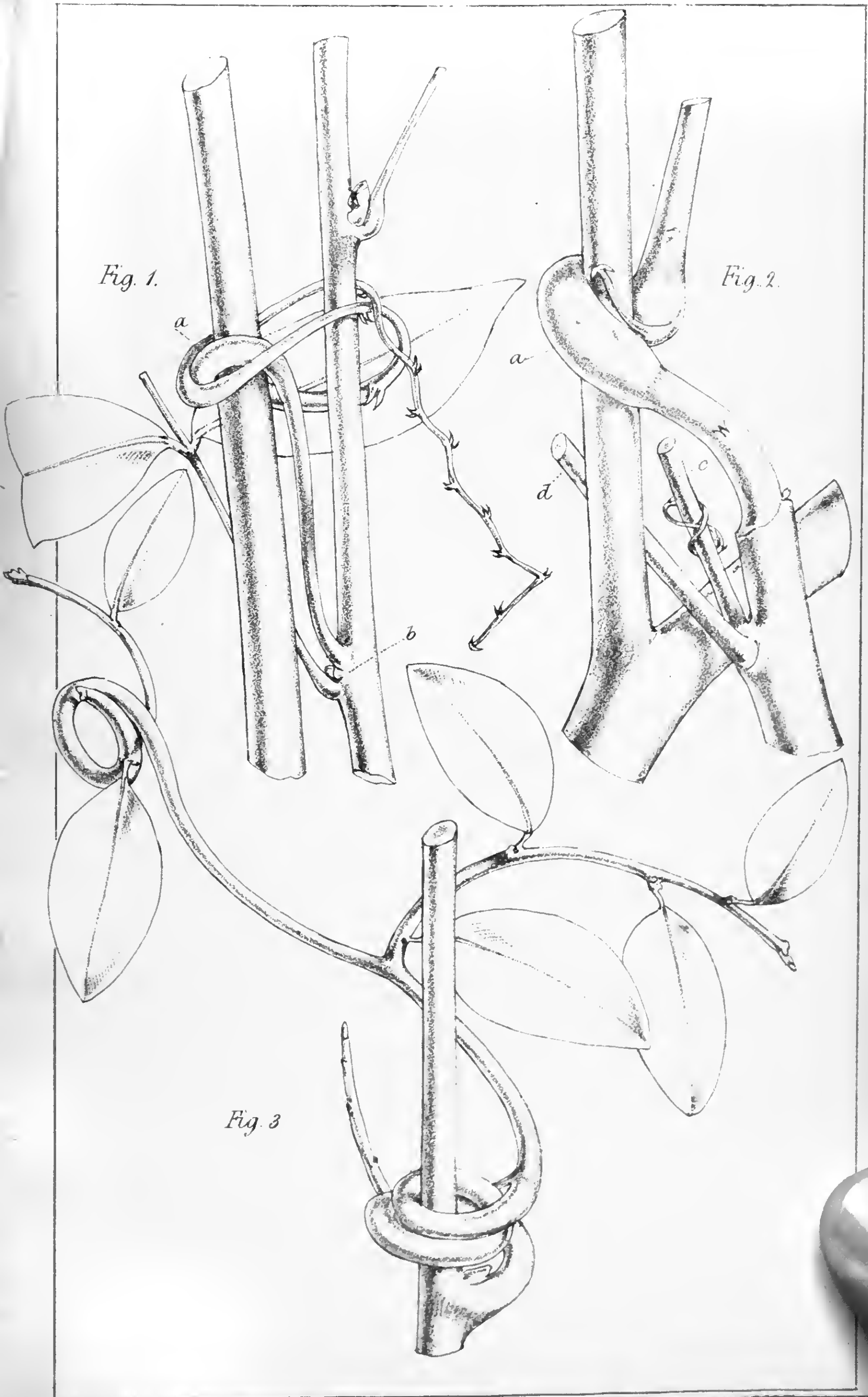
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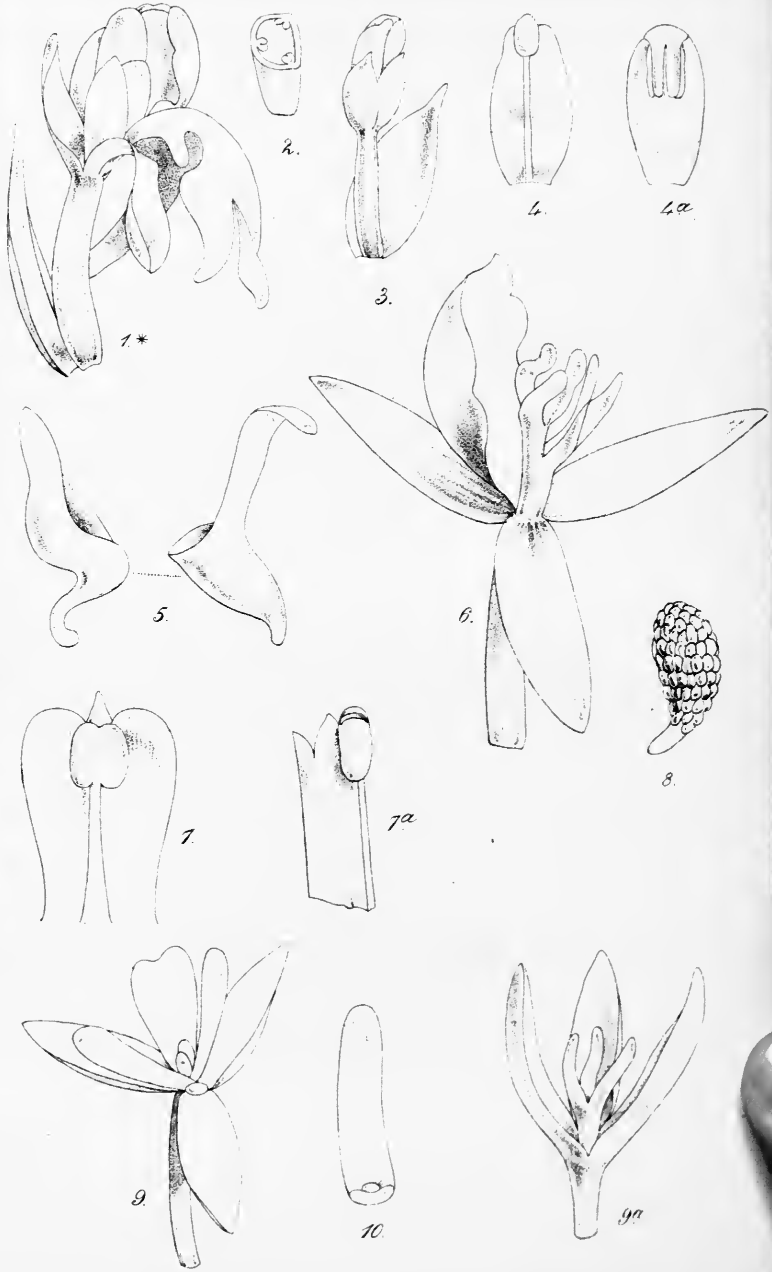
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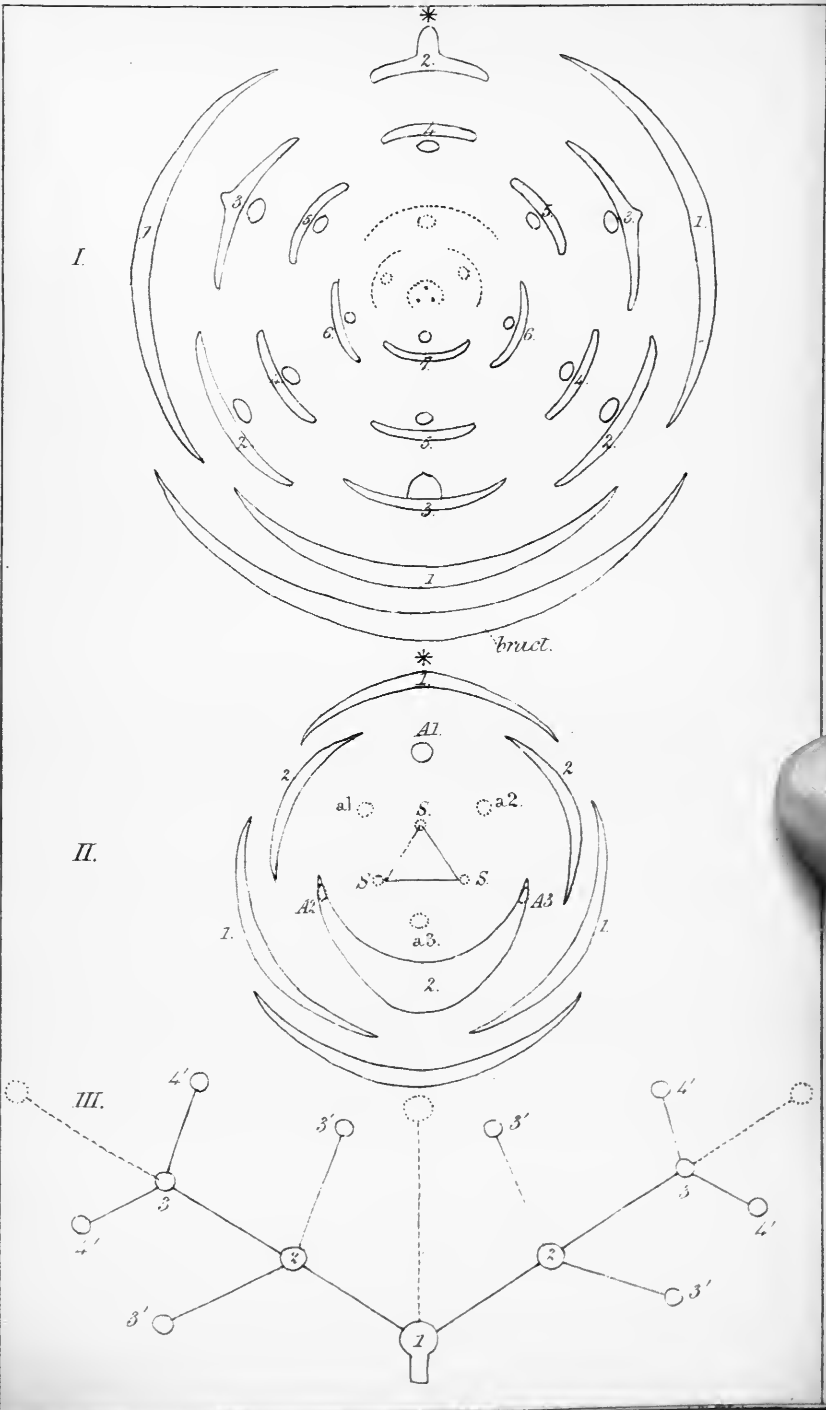

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